SIGNIFICANCE OF FOOD PROCESSING BY-PRODUCTS AS CONTRIBUTORS TO ANIMAL FEEDS

PHASE I
FOOD PROCESSING SURVEY

Prepared for:

U.S. ENVIRONMENTAL PROTECTION AGENCY

Office of Pesticide Programs
Washington, D.C.

Contract Number: 68-02-4263, EPA/HED #08

Prepared by:

Walter W. Rose
Leo D. Pedersen
Harold Redsun
National Food Processors Association
Dublin, California

R. Scott Butner
Battelle Pacific Northwest Laboratories
Richland, Washington

October 1989

DISCLAIMER

ACKNOWLEDGEMENTS

This project was sponsored by the Office of Pesticide Programs, U.S Environmental Protection Agency (EPA/OPP) under contract number 68-02-04263. The guidance of the EPA project officers Sami Malak and Philip Errico throughout the project is greatly appreciated.

Staff members of The National Food Processors Association responsible for the project included Walter W. Rose, Leo D. Pedersen and Hal Redsun. For Battelle, R.S. Butner of the Pacific Northwest Laboratories was primarily responsible for the data analysis and preparation of the draft reports.

Members of the Environment/Engineering Advisory Panel, Western Research Laboratory Committee, were very helpful in the preparation of the survey form. Also appreciation is given to selected industry members that reviewed and commented on the first draft report.

Finally, the project could not have been carried on without the voluntary assistance of numerous individuals from the food processing industry. Their cooperation in supplying the information and data required to fulfill the objectives of this survey is herewith gratefully acknowledged.

EXECUTIVE SUMMARY

This report presents the findings of a solid byproduct utilization survey conducted by the National Food Processors Association (NFPA) and Battelle-Northwest Laboratories (BNW) for the U. S. Environmental Protection Agency's Office of Pesticide Programs (EPA/OPP). The intent of the survey was to assess the amount of solid byproducts which are fed to animals as a result of food processing operations. This information will be used by EPA/OPP in determining what, if any, feed tolerance levels of pesticide residues should be established for these materials.

A Food Processing Byproduct Utilization Survey was prepared by NFPA in conjunction with BNW. The survey was mailed to 2092 food processing plants throughout the continental United States and Hawaii. The survey was mailed to plants in the following three-digit Standard Industrial Classification (SIC) groups:

- 203x - Canned and Preserved Fruits and Vegetables
- 204x - Grain Mill Products
- 206x - Sugar and Confectionery Products
- 207x - Fats and Oils (study includes vegetable and seed oils only)
- 208x - Beverages
- 209x - Miscellaneous and Prepared Foods
- 4221 - Dried Beans

Of the 2092 surveys mailed, 118 were returned undelivered, 337 were completed and returned to NFPA, and 1637 were not returned. Of the surveys completed and returned, 18.7% responded that no raw agricultural commodities (RACs) were processed and were therefore not used in the tabulation of results.

Although responses were received from slightly fewer than 16% of the plants which were sent the survey, comparison of the reported RAC tonnage with 1986 agricultural statistics (the most recent statistics for which accurate data could be obtained) show that the survey responses represent a substantial portion of the industry. Overall, the survey represents approximately 25% of the annual U.S. RAC processing volume, on a raw

commodity basis. Comparison by 3-digit SIC group show that the survey responses represented approximately 48% of the total processing volume for SIC 206x; approximately 30% of the total volume for 203x (frozen and canned foods), down to a low of 6% for SIC 4221 (dried beans). The data reported in the survey responses were principally from the 1987 processing year, which was the last completed season at the time the survey was sent.

The completed surveys were checked for external and internal consistency of data and were tabulated by SIC group, region, and RAC processed. RAC utilization for food ranged from a high value of 96% (cucumbers) to a low value of 7% (cane sugar). Utilization for feed purposes ranged from a high value of 79% (soybeans) to a low value of 0% (olives, mushrooms, cucumbers and green coffee beans). Beef cattle, followed by dairy cattle and hogs, were the most commonly reported animals fed. In many cases, RAC processors did not indicate which animals were fed.

A Research Needs Survey was also included in the survey form which was mailed to the RAC processors. This survey was included to permit processors to indicate which, if any, topics related to food processing waste management should receive additional research priority. A clear majority (82%) of the respondents believed that some additional research was needed to improve utilization of food processing byproducts and wastes. The survey identified "Energy Production from Byproducts" and "Waste Treatment/Waste Minimization" as the key research priorities among respondents. Survey responses varied significantly between SIC groups, reflecting the existing differences in byproduct utilization practices.

The majority of food processing operations included in this study reported that some portion of their solid byproducts were fed to cattle or other livestock. Relatively few of these operations reported routine monitoring of either their incoming RAC or the byproducts themselves for pesticide residue levels. Currently, residue levels on food processing byproducts are estimated on the basis of simulated processing tests conducted by the pesticide manufacturer as part of the registration of the pesticide. In the event that EPA decides that closer examination of this practice is needed, the EPA could require the pesticide manufacturers to do a more thorough study of pesticide residue levels in selected food industry segments. By utilizing

the results of this report to target industry segments which rely heavily on byproduct feeding, the EPA can minimize the costs of this follow-up study to both EPA and the industry. The results of the present study provide an excellent basis for prioritizing which industry segments should be examined. In the event that EPA elects to conduct testing of RAC byproducts for pesticide residues, a number of processing plants have been identified which would be willing to share pesticide residue data with the NFPA.

Assuming that such a study is performed, priority should be given to (a) those food processing byproducts which due to processing methods or inherent properties of the byproduct, are most likely to contain significant pesticide residues; (b) byproducts which are likely to contain significant pesticide residues as a result of agricultural practices; and (c) byproducts which are fed to cattle and other animals in large quantities or represent substantial portions of the animal's diet.

TABLE OF CONTENTS

LIST OF TABLES

Volume 1. Main Report

LIST OF FIGURES

INTRODUCTION

PURPOSE OF STUDY

The purpose of this study is to provide the U. S. Environmental Protection Agency, Office of Pesticide Programs (EPA/OPP) information regarding the disposition of solid wastes and byproducts generated by the commercial processing of raw agricultural commodities (RACs). Specifically, the EPA/OPP is interested in those byproducts such as fruit pomace, spent brewer's grains, and substandard produce, which are returned to the food chain through regular feeding to livestock and poultry.

The EPA/OPP sponsored this study in order to more adequately assess the level of pesticide residues in meat, milk, poultry and eggs. One potential pathway for introduction of these residues into the food chain is via the common practice in the food processing industry of feeding certain solid wastes and byproducts to livestock and poultry. These byproducts are generally used as feed supplements and/or roughage and may account for a substantial portion of the animal's diet. This study identifies those industries in which byproduct feeding is used and characterizes the solid byproduct streams with regard to quantities produced, seasonality, and disposition.

The EPA/OPP will use the data in this report in the evaluation of requests for tolerances of pesticide residues in or on raw agricultural commodities (food crops and animal commodities), referred to as RACs, under Section 408 of the Federal Food, Drug and Cosmetic Act (FFDCA). These tolerances are regulated under 40CFR§180. If studies indicate that residue levels in processed foods and/or animal feeds exceed the level in a RAC, food/feed additive tolerances (FAT's) for pesticides in the processed food/animal feeds will be required under Section 409 of the FFDCA. These tolerances are regulated under 40CFR§180.185 & 40CFR§180.186.

OVERVIEW OF WASTE GENERATION IN THE FOOD INDUSTRY

Types of Waste Generated by the Food Processing Industry

Because of the wide variety of RACs which are processed to provide food, as well as the variety of methods used to prepare them, food processing wastes cannot be definitively described. However, the types of solid wastes generated by the food processing industry generally fall into one or more of the following categories:

- Stem/leaf waste. This includes stem, woody vines, leaves, etc that are incidentally collected with the RAC during harvesting operations. It is removed from the commodity at the processing plant and is generally a small percentage (by weight) of the total RAC throughput. It is usually not processed to any appreciable degree, although it may undergo an initial washing or holding period in a hydrocooler, holding tank or flume. Stem and leaf waste is generally landfilled or returned to the fields as a soil enhancement.

- Cleaning/washing wastes. This includes dirt, small stones, additional leaves, and other material removed during the washing operations. Equipment used to perform these operations include flumes, wash tanks, scrubbers, screens and air scalpers. In some cases, wet cleaning operations result in the production of liquid wastes and a high-moisture sludge which is low in organic content. This material is usually disposed of in landfills or by field application.

- Sorting waste and culls. In most cases, the incoming commodities are inspected to remove immature, defective or discolored material which would adversely affect the sensory quality of the finished food product. Defective materials are also removed after peeling and cutting operations. In some cases, this culled material may find other uses in the production of more highly processed food items (for example, culled apples unsuitable for canning or applesauce production may be suitable for apple juice). In most instances, however, culled material is used for non-food uses, including livestock feed. Culls are usually subject to only minimal processing (generally some preliminary washing takes place before the sorting operation). The cull waste may or may not be mixed with other processing wastes/byproducts, depending on the specific practices of the individual processing plant.

- Peeling/coring wastes. Many RACs have protective outer tissue which must be removed prior to further processing. Examples include most hard fruits (apples, peaches, pears), root crops (beets, carrots, potatoes) and tomatoes. These peels are generally removed by mechanical means (ie, abrasion) or by thermal and/or chemical means (the use of steam or caustic solutions, respectively). Cores are removed from some fruits (apples, pears) and certain vegetables (cabbage, cauliflower). In most cases, this waste is relatively high in moisture content, which precludes long-distance hauling to feed lots. Although some of the waste may be fed

locally, most of the wastes are disposed of in landfills or are land applied.

- Pit waste. Fruit which contains hard pits (apricots, cherries, peaches, etc) along with olives, generally are pitted during processing. A small amount of fruit flesh often remains on the pit after the mechanical pitting operation. The pits are typically a moderately wet waste (50 wt% moisture is typical) but can usually be burned as fuel. In many cases, pit waste is burned as fuel to provide heat for process steam and/or electrical generation. Pit waste is not generally used as a livestock feed because of its poor digestibility. Most pit waste which is not utilized as fuel is disposed of in landfills. In some instances local regulations may prevent landfill disposal of pits due to their high moisture content.

- Milling waste. Processed meal, bran and germ from grain milling operations are almost always fed to cattle and are therefore not classified as waste materials. Most milling byproducts have been through preliminary dry cleaning and screening operations, a rolling (milling) operation, and may or may not have been water washed. Because the amount of byproduct generated is relatively large in such operations as soybean and cottonseed processing (for oil extraction), these industries rely heavily on cattle feeding operations as a market for the meal. The feed value of the meal and other milling byproducts can be as much as 10% of the total value of the commodity (Johnson and Peters, 1974).

  Corn is often processed by the "wet milling" process, which is used in the manufacture of corn syrup, starches, and sweeteners. Wet milling of corn produces a variety of solid wastes and byproducts which are distinct from those produced in dry milling operations.

- Wastewater screenings. In some processing operations (particularly in the vegetable processing industry), substantial amounts of solid material are screened from wastewater streams before they are sent to further treatment. Generally, these wastes were not quantified in the survey responses. The processors reported using these wastes for feed or soil enhancement, or they were landfilled.

In addition to the wastes mentioned above, certain industries generate specific wastes and byproducts which do not fall into these broad categories. The malting, brewing and distilling industries, for example, generate spent brewer's and spent distiller's grains. The sugar industry generates bagasse (pressed sugar cane fiber) and beet pulp (from extracted sugar beets). Processors of juice, purees and fruit pastes generate pulp and/or pomace, which is the solid pulp remaining after juice has been expressed from apples, grapes, tomatoes, and other fruits. Bagasse, beet pulp, and fruit pomace are important in the context of this study because they have the potential to concentrate pesticide residues (EPA, 1982).

Food Industry Management of Solid Wastes and Byproducts

Effective utilization of solid byproducts and residuals is a critical issue for the food processing industry. The industry generates substantial quantities of solid byproducts because not all portions of the RAC are edible, and because the visual appearance of food is often as important as its nutritive or taste quality in establishing consumer acceptance. These factors result in a substantial portion of RAC being used for non-food purposes. In order to limit the range of responses to a manageable number, survey respondents were asked to categorize their byproduct utilization in one or more of the categories listed in Table 1.

TABLE 1. Utilization Options for Food Processing Byproducts

Option	Examples
Food	Non-nutritive fiber from apple pomace; dried citrus peel; lecithin from soy beans
Feed	Desolventized cottonseed meal; sugar beet pulp; spent brewer's grains; apple and tomato pomace
Other	Essential oils from citrus; tartrates from grape lees; anthocyanin dyes from grapes, cherries; starch derivatives
Fuel	Sugar cane bagasse; peach and olive pits; rice hulls and straw; fuel ethanol from wet corn milling
Land Application	Land farming of high-solids wastewaters; land application of pomace, stem waste, and leaves.
Disposal	Landfilling of pit wastes; landfill of washing mud from vegetable processing.

Implied in the order of these options is a hierarchy of added value, with the production of food being a high value option and disposal (by landfilling) being a zero-value-added (or even a value-subtracted) option. The use of food byproducts as a feeding material for livestock is relatively high in the hierarchy of use options available to the food processor. Feeding operations provide critical revenue and may provide the margin between profit and loss in some industry segments.

The feasibility of utilizing food processing byproducts and wastes for the higher valued options is determined by a number of factors, including the physical and chemical characteristics of the waste, seasonality of the waste, quantity of waste produced, and other market and technical factors. Tabulation of the survey data revealed wide differences in solid byproduct utilization trends among commodities and between industry segments (as classified by three-digit SIC groups). Regional differences were also observed, but these differences may be more directly related to regional crop processing patterns than any other factor.

These wastes each create unique utilization opportunities or problems, and many of them represent potential pathways for pesticide residues to be returned to the food chain. Measurement of the amount of pesticide residues which are found on food processing byproducts is beyond the scope of this work and is discussed elsewhere (EPA, 1982).

STUDY METHODS

SURVEY DEVELOPMENT

The survey was developed by staff at NFPA in accordance with the objectives of the study and consistent with the way that the information is generally available to the processor. A copy of the survey package is included as Appendix D. The survey was reviewed by BNW, EPA, and food industry representatives and suggestions were made to improve its readability and the survey response rate. The final survey was then submitted for EPA and OMB approval. The survey was mailed during the month of October 1988. Follow-up mailings and telephone calls were made by NFPA to non-respondents during the period January through February 1989.

The returned surveys were coded by the NFPA to protect the identity of the respondent, and submitted to Battelle for processing. The data was stored in a database and checked for both internal and external consistency. The methods used for validating the data are described in the Database Integrity Plan, which is included as Appendix C. This report presents only the compiled data, in order to protect any possible confidential business information (CBI) which might be contained on the individual survey forms.

DATA HANDLING PROCEDURES

In order to protect CBI and/or other potentially sensitive information about the respondents operations, the surveys were sent by and returned to the National Food Processors Association (NFPA), which is the major trade organization serving the food processing industry. The surveys were copied by NFPA staff and sent to Battelle-Northwest (BNW) for processing only after the identity of the respondent had been masked. A numeric code was used to uniquely identify each response.

Data was entered into a commercial relational database file which permitted the responses to be sorted and processed according to any combination of fields. The data was subjected to tests for internal and external consistency, as well as to minimize the problem of transposed data. A random sampling of approximately 5% of the surveys was matched to the entered data to check for errors and insure that data transcription was

proceeding accurately. Some of the survey forms were returned to NFPA for resubmission or follow up calls to the respondents in order to clarify data which appeared to be in error. Finally, surveys which still did not meet tests for self-consistency, or where the respondent clearly misunderstood the intent of the questions, were occasionally deleted from the database. The procedures used to check the data are described in more detail in Appendix C.

RESULTS

The Byproduct Utilization Survey was mailed to 2092 processors of Raw Agricultural Commodities distributed among the 26 SIC codes listed in Table 2. The distribution of surveys sent and response rate are shown as a function of SIC group in Table 3. This table also shows the reported processing volume (in ton/year of RAC processed) for the SIC groups in comparison with reported 1986 agricultural statistics.

TABLE 2. List of Standard Industrial Commodity Codes Surveyed

SIC number	description
2032-2035, 2037-2038	canned specialties; canned and dehydrated fruits frozen fruits, fruit juices, vegetables and specialties
2041	flour and other grain mill products
2043	cereal breakfast foods
2044	rice milling
2046	wet corn milling
2061	cane sugar (except refining)
2063	beet sugar
2065-2066	candy and confectionery; chocolate and cocoa products
2074-2076	vegetable and seed oils
2079	shortening, table oils, and other fats and oils not listed elsewhere
2082-2085	malt beverages, wines and liquors
2087	flavor extracts
2095	roasted coffee
2099	others (potato chips, tea, spice preparation, etc)
4221	dried beans

TABLE 3. Annual RAC Processing Volume Reported by Survey Respondents

SIC	Survey Response Volume (tons RAC/yr)	1986 Processing Volume (tons RAC/yr)	(%)	# of Surveys Sent	# of Responses	Response Rate (%)
203x	9,637,066	32,325,000	29.8%	783	177	33.2%
204x(a)	6,969,808	61,991,000	11.2%	228	22	9.7%
206x	26,690,575	55,500,000	48.1%	234	37	15.8%
207x(a)	5,347,531	29,480,000	18.1%	162	24	14.8%
208x	1,116,986	14,183,000	7.9%	402	41	10.2%
209x	614,392	3,720,000	16.5%	218	27	12.4%
4221	72,796	1,145,000	6.4%	65	9	13.9%
total	50,449,155	198,344,000	25.4%	2092	337	15.6%

note: (a) 1986 data not available; 1984 data was used

A total of 337 surveys were returned to NFPA for processing by BNW, or were completed as the result of phone calls by NFPA staff. Approximately 18.7% of the respondents do not handle raw commodities and therefore did not fall under the scope of the survey. Of those respondents which do process RACs, most reported processing more than one commodity; hence the total number of data records was 500. Freezing and canning operations (SIC group 203x) were more likely to process many different commodities, while oil seed extraction plants, potato processing plants, and citrus juice plants specialized in one or two principal commodities.

Although responses were received from slightly fewer than 16% of the plants which were sent the survey, comparison of the reported RAC tonnage with 1986 agricultural statistics (the most recent statistics for which accurate data could be obtained) show that the survey responses represent a substantial portion of the industry. The survey response represents more than 50,000,000 tons of RAC processing, which is approximately 25% of the amount of RACs processed each year in the U.S. Comparison by 3-digit SIC group show that the survey responses represented approximately 48% of the total processing volume for SIC 206x; approximately 30% of the total volume for 203x (frozen and canned foods), down to a low of 6% for SIC 4221 (dried beans). The data submitted by processors were principally for 1987, which was the last completed season at the time the survey was sent.

In total, the survey responses represent more than 50,000,000 tons per year of raw commodity processing. Material balances based on the survey responses accounted for just over 75% of this material. However, if the data from SIC group 206x (sugar and confectionery) is subtracted from the survey, the accountability for the remaining RACs improves to greater than 97%. This is due to discrepancies in accounting for moisture losses, which represent sizable, unreported material flows in the cane and beet sugar industries. Similar discrepancies also existed in the citrus juice industry (primarily the frozen juice industry, represented by SIC 2037). Although the cause of the material balance discrepancy is clear in these cases, attempts to resolve the balances were not successful. The data was retained because it provides useful information about sugar industry waste management practices.

Data validation was a major undertaking, as each response could have as many as several hundred data items associated with it. Approximately 10% of the records were deleted from the tabulated results for one reason or another. The primary reason for deletion was the reporting of data which were not self-consistent - ie, reported figures did not total correctly. The generally low percentage of unaccounted for byproducts (usually less than 1 wt% by commodity) attests to the effectiveness of this approach.

In some cases surveys were returned incomplete or with incorrectly summed figures. All reported totals were checked independently and the discrepancies were resolved whenever the totals did not match to within a 5% tolerance. In particular, there were many discrepancies between the annual processing weight reported on Page 1 of Part II, and the annual weight reported on Page 2 of Part II.

In most cases the respondents did a good job of using the convention of reporting all byproducts in terms of the equivalent weights of the as-received RAC. Because of the influence of moisture content on reported weights, this was probably a fortuitous result. In several cases however, analysis of the data revealed that if reported weights for all byproducts were corrected to a common moisture content (the moisture content of the incoming RAC was used by convention), the total weight of unaccounted

material was eliminated and the mass balance around the operation was closed. This was done for approximately 5% of the responses and found to be a consistently effective approach for several completed surveys.

SUMMARY BY RAC

Overall Results

Survey responses were grouped by RAC, with a total of 41 RAC categories being reported. Table 4 lists the number of responses for each RAC and the total annual tonnage of each RAC reported in the survey. Byproduct utilization rates for each of the listed use/disposal categories are also shown. When fewer than five responses were received for a given RAC, the number of responses is indicated as "<5" in order to prevent inadvertent release of sensitive production data which could be inferred from more detailed information.

Other than the "Processing Volume" column, which is the total reported processing volume for each RAC (expressed in tons/year of RAC), the data in Table 4 are expressed as percentage utilization of the RAC for each of the listed utilization options. "Food Uses" included all identified food products, including secondary food products such as dietary fiber from apple pomace and bran products from grain milling. "Feed Uses" are listed as either wet feed or dry feed. Although moisture content data were occasionally provided by the food processor, the determination of whether a feed material was listed as a wet feed or a dry feed was generally left to the processor. It was impossible from these data results to determine an accurate distribution of feed markets, since processors generally did not indicate which animals were being fed. "Land Application" includes all materials returned to land intended for agricultural use, regardless of the purpose. "Fuel" uses were limited to direct combustion or gasification and did not include the generation of biogas or ethanol for fuel purposes.

In Table 4, "Other" refers to byproduct uses not listed on the survey, as well as to quantified losses of materials from the process (for example, though solids lost in vegetable blanching operations, or roasting losses in the preparation of roasted coffee beans). Table 5 lists byproducts and wastes which were reported in the "Other" Column.

TABLE 4. RAC Processing Volume (tons RAC/year) and Utilization Rates

RAC	# of Responses (count)	RAC Processing volume (tons/y)	RAC Utilization Rates (wt% of RAC)							
			Food	Wet Feed	Dry Feed	Land Applied	Fuel	Land-filled	Other	Unaccounted
Almonds	<5	258,971	69%	2%	2%	0%	27%	0%	0%	0%
Apples	11	177,431	68%	15%	0%	3%	0%	3%	4%	6%
Berries	16	29,429	80%	4%	0%	2%	0%	9%	4%	0%
Cabbage	13	72,615	73%	4%	0%	19%	0%	4%	0%	0%
Carrots	21	118,344	47%	40%	0%	2%	1%	1%	10%	0%
Cherries	16	22,234	75%	2%	0%	9%	1%	7%	6%	0%
Citrus	10	839,512	15%	9%	8%	0%	0%	0%	0%	68%
Coffee	6	67,278	90%	0%	0%	0%	0%	0%	10%	0%
Cottonseed	8	1,036,662	16%	11%	58%	0%	0%	1%	0%	14%
Cucumbers	<5	18,815	96%	0%	0%	0%	0%	4%	0%	1%
Dry beans & peas	39	133,288	93%	1%	4%	1%	0%	1%	0%	0%
Grapes	20	170,001	88%	2%	0%	6%	0%	3%	1%	0%
Green beans	19	210,071	77%	13%	0%	9%	0%	1%	1%	0%
Green peas	26	144,684	88%	11%	0%	1%	0%	0%	0%	0%
Greens	6	21,898	74%	15%	4%	6%	0%	1%	0%	0%
Lima beans	9	9,270	91%	7%	0%	1%	0%	0%	0%	0%
Malt	10	997,153	63%	12%	5%	0%	0%	1%	0%	19%
Misc fruit	8	193,623	81%	2%	0%	0%	0%	16%	0%	0%
Misc vegetables	12	402,653	49%	44%	0%	5%	0%	0%	1%	0%
Mushrooms	<5	7,451	70%	0%	0%	0%	0%	1%	28%	0%
Olives	<5	18,338	71%	0%	0%	0%	27%	2%	0%	0%
Onions	<5	10,109	64%	20%	5%	1%	0%	0%	9%	0%
Peaches	23	532,510	79%	3%	0%	8%	4%	4%	2%	0%
Peanuts	6	108,803	84%	0%	7%	2%	7%	1%	0%	0%
Pears	12	294,804	77%	3%	0%	9%	0%	6%	6%	0%
Peppers	12	33,336	67%	17%	0%	2%	0%	13%	1%	0%
Pineapples	<5	214,650	86%	8%	0%	0%	0%	6%	1%	0%
Potatoes	30	2,444,300	48%	25%	4%	8%	0%	0%	0%	15%
Prunes	11	93,841	62%	4%	0%	0%	1%	16%	17%	0%
Raisins	<5	100,200	91%	0%	2%	0%	0%	0%	6%	1%
Rice	<5	826,624	65%	0%	23%	0%	5%	1%	5%	1%
Shelled corn	15	4,400,746	58%	14%	12%	0%	0%	0%	0%	16%
Soybeans	12	4,314,215	20%	0%	79%	0%	0%	0%	1%	0%
Squash	9	44,719	86%	9%	0%	2%	0%	3%	0%	0%
Sugar beets	18	10,972,597	13%	2%	6%	0%	0%	0%	0%	79%
Sugar cane	<5	15,418,348	7%	2%	0%	0%	19%	4%	0%	68%
Sweet corn	29	962,445	34%	59%	0%	2%	0%	0%	5%	0%
Sweet potatoes	8	54,092	62%	20%	0%	16%	0%	2%	0%	0%
Table beets	11	97,183	48%	23%	0%	23%	0%	0%	6%	0%
Tomatoes	23	2,775,664	84%	3%	0%	2%	0%	0%	0%	11%
Wheat	7	1,800,247	74%	0%	24%	0%	0%	0%	1%	1%
Total	500	50,449,155	30%	6%	12%	1%	6%	2%	1%	42%

TABLE 5. Unclassified Byproducts and Wastes from Several RACs

RAC	Waste/Byproduct
Apples	Pectin
Citrus	Peel, essential oils
Coffee	Roasting losses
Cottonseed	Linters
Malt	Carbon dioxide (fermentation byproduct)
Peaches	Peach pits for fragrance manufacture
Potatoes	Biogas (used for fuel), starch, moisture losses
Raisins	Fermentation of wet salvage raisins
Shelled corn	Industrial starches, steepwater losses
Soybeans	Moisture losses, soy solubles, soapstock from oil
Sugar beets	Moisture losses
Sugar cane	Moisture losses, bagasse board
Sweet corn	Soluble solids
Tomatoes	Evaporation losses
Vegetables	Blanching and cleaning losses
Wheat	Biogas

The column labeled "Unaccounted" includes all unquantified losses, and therefore represents the error in the process material (mass) balance. This material is lost during product concentration (water losses), cleaning and fluming (soluble solids losses), and spillage (RAC losses). Moisture (evaporation) losses are by far the greatest contribution to mass balance errors. The Unaccounted column was calculated from the total of all other uses, including "Others." In most instances, the unaccounted material represents a small fraction (less than 1%) of the incoming RAC. Exceptions include citrus, sugar cane and sugar beet, and tomatoes. Each of these RACs requires a substantial reduction of water content during processing, and the large unaccounted portion represents this moisture loss. Moisture losses in other commodities were generally accounted for in the survey data. Other RACs with significant moisture losses which could not be reconciled from survey data included apples (6%); cottonseed (13.9%); malted products (19.2%) and potatoes (14.5%). Soluble solids losses are a likely contributor to mass balance errors for potatoes and wet milling of shelled corn.

Utilization Profiles

Data for each of the 41 RACs included in the survey responses were compiled into a RAC profile in order to identify trends with regard to

disposal of solid food byproducts. The profiles are presented in Appendix A. The profiles briefly describe the processing of the RACs, with emphasis on identification of byproduct sources within the process. The residual uses listed in the profiles reflect only the responses to the survey and do not include all known uses. Detailed survey information which was judged to pose a risk of disclosing confidential business information was not reported.

The process flowsheets included with each RAC profile are representative of the flowsheets returned with the surveys. In some cases, additional details from published food processing references (Johnson and Peterson, 1974) were utilized. Generally, packaging and storage operations and other processing operations which were reported to contribute little to the residual stream were not included in the flowsheets.

SUMMARY BY SIC

Survey respondents were asked to list up to five four-digit SIC codes which applied to their processing plants. Most respondents included only the one or two codes, which were reviewed for correctness by NFPA staff upon receipt of the completed survey forms. For the purposes of data tabulation, three digit categories were used because of the majority of the respondents fell into more than one SIC code. Table 6 shows the RAC utilization trends and total RAC processing volume (in tons RAC/yr) by SIC group. Listing wastes by 3-digit SIC group is also a useful approach because many of the wastes within a given group are relatively similar. Wastes typical of the SIC group included in the study are described below.

TABLE 6. Total Tonnage Reported (Grouped by SIC Group)

SIC Group	Number of Responses	RAC Utilization Volume (tons/yr) RAC Wt.	Food Wt.	Wet Feed Wt.	Dry Feed Wt.	Land Applied Wt.	Fuel Wt.	Landfilled	Other Wt.	Mass balance Error (wt%)
203x	380	9,637,066	6,038,174	1,617,210	170,153	445,365	26,601	149,748	731,612	5%
204x	17	6,969,808	4,396,572	600,000	1,136,396	1,559	42,648	7,546	662,504	2%
206x	27	26,690,575	2,621,167	540,441	625,668	23,230	3,059,992	686,462	7,146,780	45%
207x	19	5,347,531	1,012,693	112,927	4,009,651	0	5,080	11,866	177,196	0%
208x	22	1,116,986	730,000	126,603	49,987	7,447	0	10,767	188,661	0%
209x	23	614,392	285,327	113,183	9,076	3,755	0	3,262	204,731	-1%
4221	12	72,796	59,621	3,075	6,242	0	0	756	3,255	0%
Total	500	50,449,155	15,143,553	3,113,438	6,007,172	481,356	3,134,320	870,406	9,114,740	25%

note: large mass balance errors on SIC 206x are due to evaporation losses which were not reported.

SIC 203x (Canning, Freezing and Pickling)

Canning and freezing byproducts are primarily derived from sorting and grading operations, but include material removed during washing and cleaning operations. In some of the larger canning plants, wastes which are associated with water treatment plants (such as settled and screened solids, digestor sludge, etc) are also reported. Spillage and defective products are also commonly reported residual components, but generally these amount to only a few percent of the total processing volume. Disposition of canning and freezing byproducts varied depending upon the quantity and characteristics (digestibility, nutritive value, moisture content) of the byproduct.

SIC 204x (Grain Milling)

Milling operations are generally limited to the processing of grains such as wheat, corn and rice, although milling is also used as a preliminary step in the extraction of oils from oil seeds. This category also includes the wet milling of corn to produce corn starches and sweeteners. The purpose of grain milling is to remove the tough outer portion of the grain (bran) and facilitate separation of the other components (ie, germ). Depending on the RAC being processed the bran and germ may be treated as byproducts, rather than as food products. When they are not used for food purposes, they are usually sold for their feed value. Other sources of byproducts include undersized or otherwise defective grain, and the dirt, sticks, and stones removed during screening and air cleaning operations. This material is usually landfilled.

SIC 206x (Sugar and Confectionery)

Survey responses in this category represented the largest single contribution to the total tonnage reported in the survey and therefore heavily influence the overall byproduct utilization averages. Byproducts from the production of sugar include pressed sugar cane (bagasse), extracted sugar beet pulp, beet tops and leaves. Processors which refined their own sugar also produce waste molasses, which is usually fed to cattle. Cane sugar operations generally do not refine their own sugar; however, most of the beet sugar processors reported having molasses available as a residual.

Survey responses show that sugar cane byproducts are used primarily (about 90%) for fuel, while sugar beet pulp byproducts are used almost exclusively (>90%) for cattle feeding.

SIC 207x (Fats and Oils)

This category includes cottonseed oil mills, soybean oil mills, and peanut oil mills. Refiners of edible oils (SIC 2079) were excluded from the survey because they do not process RACs and do not generate RAC byproducts. The processes in this category are basically milling operations followed in most cases by solvent (usually hexane) extraction of the milled meal. Byproducts include desolventized meal, along with dirt and trash from the screening and cleaning operations. Cottonseed mills also produce linters as a non-feed residual. Oil seed milling operations rely heavily on feeding operations as a means of utilizing extracted meal byproducts.

SIC 208x (Beverages)

The primary respondents in this category were producers of beer and other malt beverages (SIC 2082), although producers of distilled liquors (SIC 2085) were also represented. Spent brewer's and distiller's grains were the primary residual reported in this category. These byproducts are widely used as livestock feed.

SIC 209x (Miscellaneous Foods)

This category included processors of raw (green) coffee beans, although some potato and corn chip manufacturers were also included. Coffee byproducts are discussed in the RAC Profiles (Appendix A).

SIC 4221 (Dried Beans)

This category includes processors of dry beans & peas who produce a packaged, raw dry bean product. Processing is generally limited to cleaning and drying the beans. Byproducts from this category are limited to dirt and other trash separated during screening and air scalping and to spilled or rejected beans. These materials have usually undergone relatively little processing, and are most often landfilled.

SUMMARY BY REGION

Survey results were also compiled against the geographic region of the processing plant. The survey regions are shown in Figure 1, and the states belonging to each region are listed in Table 7. Completed surveys were assigned to one of eight regions by NFPA staff, based upon the business address of the survey respondent. Survey respondents were also asked on the survey to list the state or country of origin for each commodity. A state-by-state breakdown of reported tonnage was not possible, since in almost every case, the survey respondents did not provide this information. No surveys were sent to Region 8 (Alaska) because the principal food industry (fish and seafood) was not within the scope of the study. Although individual states' contributions could not be quantified from the information provided by the processors, RACs were reported as having originated in every state and territory except Connecticut, New Hampshire, New Jersey, Nevada, Rhode Island, Virginia, West Virginia and Puerto Rico.

RACs which have been imported from other countries are also of interest to the EPA. Few survey respondents reported processing imported RACs, and those which did process imported RACs generally processed RACs from domestic sources as well. Since processing data did not differentiate between imported and domestic RAC, the impact of imported RAC could not be quantified. Table 8 is a list of imported RACs and the survey regions where they were processed.

A regional breakdown of reported processing volume and byproduct utilization is shown in Table 9. A tabulation of reported RAC processing volume (in tons RAC/year) by RAC and region is shown in Table 10. While apparent differences in utilization trends were expected, and indeed observed among regions, it is not clear whether the observed variations in utilization are due to regional crop preferences, or to other regional factors such as transportation costs, climate, etc.

TABLE 7. States in Survey Regions

Region	States in Region
1	Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont
2	New Jersey, New York, Pennsylvania
3	North and South Carolina, Delaware, Florida, Georgia, Maryland, Puerto Rico, Virginia, West Virginia
4	North and South Dakota, Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, Ohio, Wisconsin
5	Alabama, Arkansas, Kentucky, Louisiana, Mississippi, Oklahoma, Texas
6	Colorado, Montana, New Mexico, Utah, Wyoming
7	Idaho, Oregon, Washington
8	Alaska (not included in survey)
9	Arizona, California, Hawaii, Nevada

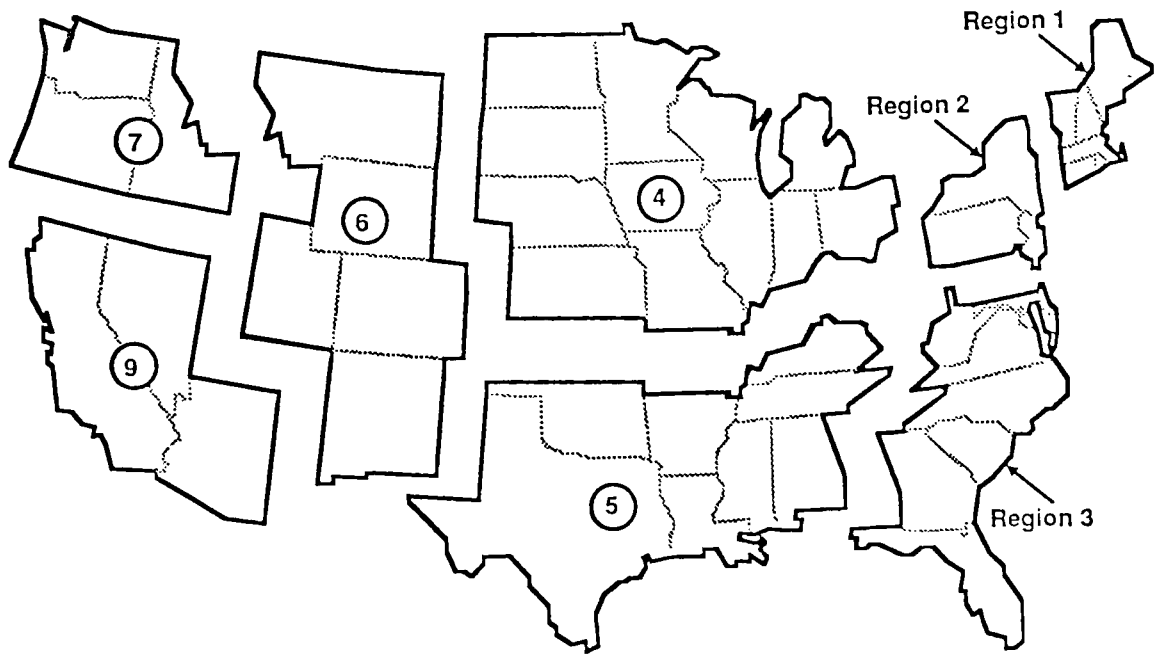


FIGURE 1. NFPA Food Processing Regions

TABLE 8. Imported RACs

RAC	Source of Import	Region where Processed
Apples, berries	Canada	Region 7 (Pacific NW)
Coffee	Asia	Region 4 (Midwest)
Dry beans and peas, broccoli, brussel sprouts, carrots, celery, cucumbers, okra, peppers, snap and snow peas, squash, and tomatillos (green tomatoes)	Mexico	Region 4 and 5 (primarily Texas)

TABLE 9. RAC Utilization by Region

			RAC Utilization Rate (% of RAC)							
Region	Number of Responses	RAC Wt.	Food	Wet Feed	Dry Feed	Land Applied	Fuel	Landfilled	Other	Mass balance Error (a)
1	12	493,670	33%	24%	15%	1%	0%	1%	27%	0%
2	36	1,201,850	69%	5%	18%	2%	0%	1%	6%	0%
3	23	1,083,698	20%	1%	24%	0%	1%	0%	7%	46%(b)
4	163	13,947,077	39%	8%	28%	1%	0%	0%	24%	1%
5	62	3,445,801	32%	2%	30%	1%	5%	1%	23%	6%
6	6	1,636,998	13%	0%	5%	0%	0%	0%	76%	5%
7	83	2,917,570	54%	30%	1%	8%	0%	1%	10%	-4%
9	115	25,722,491	22%	3%	1%	0%	12%	3%	12%	46%(b)
Total	500	50,449,155	30%	6%	12%	1%	6%	2%	18%	25%

notes: (a) mass balance error is the relative error, 100% Σ(RAC Use Rates)

(b) error is traceable to large evaporative losses from sugar beets and sugar cane

TABLE 10. RAC Processing Volume by Region

RAC	Processing Volume (tons RAC/yr)	Processing Volume in Region (tons RAC/yr)							
		1	2	3	4	5	6	7	9
Almonds	258,971	2,112	0	0	0	0	0	0	256,859
Apples	177,431	0	20,000	1,208	30,443	9,180	0	68,398	48,202
Berries	29,429	6,002	4,909	0	0	130	0	5,613	12,775
Cabbage	72,615	950	55,011	0	16,654	0	0	0	0
Carrots	118,344	0	1,539	0	31,587	18,699	0	44,677	21,842
Cherries	22,234	0	0	0	3,000	85	214	14,230	4,705
Citrus	839,512	0	0	656,778	0	19,399	0	0	163,336
Coffee	67,278	0	15,236	3,934	16,500	0	0	0	31,608
Cottonseed	1,036,662	0	0	0	0	891,062	0	0	145,600
Cucumbers	18,815	0	0	0	18,815	0	0	0	0
Dry beans & peas	133,288	200	269	9,284	25,933	31,015	15,000	23,128	28,459
Grapes	170,001	107	22,222	0	1,843	0	0	437	145,393
Green beans	210,071	0	25,168	83	127,610	11,020	0	46,190	0
Green peas	144,684	0	1,605	0	101,228	0	0	41,851	0
Greens	21,898	0	0	354	789	20,755	0	0	0
Lima beans	9,270	0	141	0	4,308	0	0	4,821	0
Malt	997,153	72,099	124,841	39,532	102,759	8,140	0	231,916	417,866
Misc fruit	193,623	0	0	0	0	0	0	0	193,623
Misc vegetables	402,653	0	0	0	49,210	1,981	0	351,081	382
Mushrooms	7,451	0	7,250	0	0	0	0	0	201
Olives	18,338	0	0	0	0	0	0	0	18,338
Onions	10,109	0	0	0	2,187	1,800	0	5,067	1,055
Peaches	532,510	3	0	0	5,032	5,120	0	800	521,555
Peanuts	108,803	0	0	35,410	5,249	68,144	0	0	0
Pears	294,804	0	0	0	3,957	5,940	0	125,775	159,132
Peppers	33,336	0	0	0	155	28,678	0	0	4,503
Pineapples	214,650	0	0	0	0	0	0	0	214,650
Potatoes	2,444,300	403,197	37,217	71,500	283,519	4,649	0	1,641,718	2,500
Prunes	93,841	0	0	0	4,071	1,810	0	6,124	81,836
Raisins	100,200	0	0	0	0	0	0	0	100,200
Rice	826,624	0	0	0	0	826,624	0	0	0
Shelled corn	4,400,746	0	3,923	15,114	4,371,337	372	0	10,000	0
Soybeans	4,314,215	0	0	240,000	3,813,312	260,903	0	0	0
Squash	44,719	0	0	0	2,801	4,870	0	9,130	27,918
Sugar beets	10,972,597	0	0	0	3,144,491	805,000	1,618,784	0	5,404,322
Sugar cane	15,418,348	0	0	0	0	360,915	0	0	15,057,433
Sweet corn	962,445	0	36,421	0	660,297	0	0	265,727	0
Sweet potatoes	54,092	0	0	5,500	0	46,642	0	0	1,950
Table beets	97,183	9,000	18,846	0	37,189	11,260	0	20,888	0
Tomatoes	2,775,664	0	20,000	5,000	89,806	1,608	3,000	0	2,656,250
Wheat	1,800,247	0	807,253	0	992,994	0	0	0	0
Total	50,449,155	493,671	1,201,852	1,083,701	13,947,081	3,445,806	1,637,004	2,917,577	25,722,500

Results of the Research Needs Survey

In addition to waste utilization information, food processors were asked to identify additional waste utilization research needs (see Part III of the survey form in Appendix D). The processors were also asked whether or not they monitored for pesticide residues on RACs and/or byproducts, and whether they would be willing to share this data with NFPA. Space was also provided for additional comments regarding the survey.

A total of 281 Research Needs Surveys were completed and returned. All of the research needs surveys which were submitted were included in the tabulation of results even if the byproduct utilization data was not used. Tables 11 and 12 show the survey results by region and by SIC, respectively.

Table 13 shows the relative distribution of respondents within each region and SIC group. Responses from the SIC 203x group predominate nearly every region, although regions 5 and 6 show significant numbers of responses from SIC group 207x and 206x, respectively. It should be noted that these distributions represent the numbers of respondents and do not take reported RAC processing volumes into consideration.

TABLE 11. Research Needs Survey Results (by SIC Group)

	SIC Group							
SIC Group	203x	204x	206x	207x	208x	209x	4221	Survey Total
# of Responses	153	18	26	23	33	20	8	281
More Research	86%	72%	81%	70%	82%	90%	63%	83%
Energy from Waste	43%	61%	77%	39%	42%	65%	38%	48%
New Foods	30%	33%	15%	4%	48%	20%	25%	28%
Feeds from Waste	57%	39%	42%	17%	39%	30%	38%	47%
Waste Minimization	40%	33%	46%	22%	30%	55%	0%	37%
Waste Treatment	29%	17%	46%	39%	15%	20%	13%	28%
Other (see Table 14)	3%	0%	19%	0%	6%	0%	0%	4%
Monitor for Residues	31%	50%	50%	43%	21%	20%	25%	33%
Will Share Data	14%	22%	19%	22%	6%	5%	13%	14%

TABLE 12. Research Needs Survey Results (by Region)

	Survey Region								Survey Total
	1	2	3	4	5	6	7	9	
# of Responses	5	31	18	86	39	6	32	64	281
More Research	80%	87%	83%	80%	79%	67%	81%	88%	83%
Energy from Waste	60%	61%	61%	50%	41%	50%	31%	48%	48%
New Foods	20%	26%	22%	24%	28%	0%	28%	39%	28%
Feeds from Waste	40%	39%	39%	51%	41%	0%	50%	53%	47%
Waste Minimization	80%	39%	39%	36%	26%	50%	31%	44%	37%
Waste Treatment	20%	10%	28%	24%	36%	50%	28%	34%	28%
Other (See Table 14)	0%	0%	0%	7%	0%	17%	3%	5%	4%
Monitor for Residues	20%	32%	11%	22%	33%	67%	41%	48%	33%
Will Share Data	0%	3%	6%	9%	21%	0%	16%	25%	14%

TABLE 13. Percentage of Survey Respondents Classified by SIC and Region

SIC	# of Responses	% of Survey Region in SIC Group								
		1	2	3	4	5	6	7	9	overall
203x	153	40%	48%	44%	52%	31%	33%	88%	64%	55%
204x	18	0%	7%	0%	13%	13%	0%	0%	0%	6%
206x	26	20%	0%	11%	8%	8%	50%	0%	16%	9%
207x	23	0%	3%	6%	12%	26%	0%	0%	2%	8%
208x	33	20%	23%	22%	5%	18%	0%	6%	13%	12%
209x	20	20%	19%	17%	8%	5%	0%	0%	2%	7%
422x	8	0%	0%	0%	2%	0%	17%	6%	5%	3%
all	281	2%	11%	8%	30%	14%	2%	11%	22%	100%

The results of the research needs survey can serve as guidance for the development of research programs addressing the food processing industry. The data show fairly high support for additional research in general, with a pronounced emphasis in the areas of energy recovery from food processing wastes, waste minimization, and identifying new feed opportunities for byproducts. Other observations include the high interest in "energy from wastes" indicated by SIC group 206x. This group is dominated by the sugar processing industry, which already uses a substantial portion of its byproducts (bagasse) as fuel. This result can be explained by the high energy intensity of the sugar processing industry.

Several respondents indicated the need for "Other" research needs - ie., those which were not listed as choices on the survey. In fact, however, many of their comments indicated that they were simply elaborating on needs already identified as survey choices. For example, nearly 20% of the respondents in SIC 203x (sugar and confectionery) had checked the "Others" box on the survey. A review of the comments which were included in these responses show that several processors of sugar beets indicated that use of beet pulp and other byproducts as soil enhancers needs further study. This is clearly a choice presented in the research needs survey; however, the comments are noted as additional emphasis for that need. Other research needs mentioned in the comments included those listed in Table 14.

TABLE 14. Additional Research Needs identified by Survey Respondents

# of Responses	SIC Group	Identified Need
6	203x, 206x	Secondary agricultural use (includes feeding and land application)
2	203x	Cyclic nature of waste production/matching waste stream volume to user needs
2	203x	Reduction/treatment of brine wastes
1	203x	Liquefaction of solid wastes to permit spray irrigation/land application
1	207x	Reduction of solvent losses to atmosphere (oilseed processing)
1	203x	Fuel use of cherry and plum pits

A total of 93 survey respondents indicated that they monitored either RACs or the processed byproducts. Of these, 39 (42%) would be willing to share pesticide monitoring data with the EPA. Comments on survey responses showed that plant managers often may not have the authority to disclose this data without corporate approval. In a number of other cases, the respondent indicated that pesticide monitoring data was being collected by an outside agency (such as the USDA) or by the growers (who then must certify the RAC as meeting pesticide residue standards). A list of processing plants willing to share monitoring data will be kept by the NFPA for later use, if needed.

DISCUSSION

The results of this survey make it clear that substantial quantities of food industry byproducts are used as feed for cattle, hogs, poultry, and other farm animals. Furthermore, it is apparent that selected industries rely heavily upon this practice, both for waste disposal and for generation of revenue. Industries such as the oilseed extraction, brewing, and fruit and vegetable processing industries rely on feeding of byproducts for utilization of up to 70% of the total weight of RAC processed in their plants.

This data can be cited as good evidence that the food processing industry is practicing effective byproducts management by finding relatively high-valued uses for this material. While there appears to be no immediate conflict between this practice and the public health, the data in this report will provide EPA with a better understanding of industry byproduct utilization trends which can be used by EPA in the assessment of pesticide residue pathways through the food chain. This data should prove useful, since, although consideration of the effects of processing on pesticide residuals is a prescribed part of the licensing process for new pesticides (EPA, 1982), the extent of food processing byproduct feeding has not been well documented in the past. Even the most comprehensive documentation identified by the author (Katsuyama, et al. 1973), while quite complete, is somewhat dated.

The full extent of any potential health risks posed by the industry practice of byproduct feeding should be evaluated on the basis of actual processing wastes. A number of processors contacted through this survey effort would be willing to share pesticide monitoring data. A list of processors has not been included in this survey in order to protect their identities.

The majority of food processing operations included in this study reported that some portion of their solid byproducts were fed to cattle or other livestock. Relatively few of these operations reported routine monitoring of either their incoming RAC or the byproducts themselves for pesticide residue levels. Currently, residue levels on food processing byproducts are estimated on the basis of simulated processing tests conducted

by the pesticide manufacturer as part of the certification of the pesticide. In the event that EPA decides that closer examination of this practice is required, the EPA could require the pesticide manufacturers to do a more thorough study of pesticide residue levels in selected food industry segments. By utilizing the results of this report to target industry segments which rely heavily on byproduct feeding, the EPA can minimize the costs of this follow-up study to both EPA and the industry. The results of the present study provide an excellent basis for prioritizing which industry segments should be examined. In the event that EPA elects to conduct testing of RAC byproducts for pesticide residues, a number of processing plants have been identified which would be willing to share pesticide residue data with the NFPA.

Assuming that such a study is performed, priority should be given to (a) those food processing byproducts which due to processing methods or inherent properties of the byproduct, are most likely to contain significant pesticide residues; (b) byproducts which are likely to contain significant pesticide residues as a result of agricultural practices; and (c) byproducts which are fed to cattle and other animals in large quantities or represent substantial portions of the animal's diet.

REFERENCES

Johnson, A. H. and M. S. Peterson. 1974. Encyclopedia of Food Technology, AVI Publishing Co., Westport, CT.

Katsuyama, A. M., Olson, N. A., Quirk, R. L., and W. A. Mercer. 1973. Solid Waste Management in the Food Processing Industry. EPA-SW-42C-73. National Technical Information Service, Springfield, VA.

U. S. Environmental Protection Agency. 1982. Pesticide Assessment Guidelines, Subdivision O: Residue Chemistry. EPA-540/9-82-023. U.S. EPA, Washington, D.C.

APPENDIX A - RAC Utilization Profiles

CONTENTS OF APPENDIX A

INTRODUCTION TO RAC PROFILES

The RAC profiles contained in this appendix have been included in order to present more detailed information regarding the processing of the individual RACs reported by food processors in response to the NFPA/EPA Food Processing Byproduct Survey. The profiles consist of five sections, which are described below.

RAC Summary

This section includes a listing of all food products made from the RAC and reported in the survey; a list of all animals reported fed in the survey; and the portions of the RAC which are reported fed. In general, food processors did not report the distribution of animals fed, and usually reported more than one type of animal.

RAC Utilization Profile

This table presents the survey statistics for the individual RAC, including the range and mean of the reported moisture content for each RAC, food, and byproduct stream for which data was provided. The values listed are the actual survey statistics; the processor's classification of feeds as either wet or dry feeds were taken at face value, and in some cases, feeds listed as wet feeds are well below the moisture content criteria for such materials. Where data was not provided by any of the survey respondents, the missing data value is represented by "n.r." (not reported). Also provided in this table are the total processing volume (in tons RAC/yr) and the range and mean utilization rates for each of the listed utilization options.

RAC Processing Practices

This narrative describes in general terms the processing of the RAC, emphasizing the reported handling of the byproducts. Alternate uses (generally reported under the "Other" heading in the RAC Utilization Profile) are also described.

RAC Processing Volume

This section contains a table listing the RAC production volume (expressed in tons RAC/yr) by region, and a figure showing the reported processing volume (also in tons RAC/yr) for each of the 12 months covered by the survey. In most cases, the data covers the 1987 processing season.

RAC Processing Flowsheet

Processing flowsheets were created based on the flowsheets submitted by food processors in response to the survey. Slight variations between individual flowsheets were not included in the flowsheets, as in many cases, this would have required several pages of flowsheets for each RAC. The flowsheets were simplified to emphasize the production of wastes and byproducts, and in most cases, combine steps where byproduct production does not generally occur. For example, in canning operations, cooking operations are always followed by cooling (quenching) operations, as well as labeling and casing operations. In the RAC processing flowsheets, this is usually shown by the single step labeled "cooking."

COMMODITY: Almonds

PRODUCTS MADE: Roasted whole and cut almonds; various confectionery.

ANIMALS FED: Beef and dairy cattle.

PORTIONS FED: Skins fed as a wet (50 wt% moisture) waste.

TABLE A1. RAC Utilization Profile for Almonds

	Moisture Content (wt%)				RAC Utilization (see note a)			
Disposition	Min	Max	Mean	σ	Weight	Min	Max	Mean
RAC	5.0	6.5	5.8	0.8	258,971	2,112	256,859	129,486
Food Product	5.0	6.5	5.8	0.8	178,022	69%	96%	69%
Wet Feed	50.0	50.0	50.0	0.0	4,167	0%	2%	2%
Dry Feed	16.9	16.9	16.9	0.0	5,918	0%	2%	2%
Land Applied	n.r.	n.r.	n.r.	n.r.	0	0%	0%	0%
Land Filled	n.r.	n.r.	n.r.	n.r.	0	0%	100%	0%
Burned	5.0	5.0	5.0	0.0	70,781	0%	28%	27%
Other	-				0	0%	0%	0%
Unaccounted for					83			0%

note (a): Values are in wt% of total RAC, except RAC and weight figures, which are in total tons/year.
n.r. indicates that data was not reported by survey respondents.
() around data value indicates a negative mass balance error.

Processing Practices

Following harvest, almond hulls are removed and may be fed to cattle. In some instances, hulls are removed in the field and are not included in processing. Nut meats (kernels) in the shell are mechanically shelled, and the whole shelled kernels are either packaged as whole, raw or roasted almonds or blanched and further processed prior to packaging. Blanching generates a wet skin waste (50 wt% m.c.) which may be fed to cattle. Shells are a dry waste (5-8 wt% m.c.) and may be used as a fuel, or other commercial non-food uses (ie, grinding/polishing media).

BLE A2. Reported Processing Volume (tons/year) for Almonds

Total Vol (tons/yr)	Processed Volume in Survey Region (Tons RAC/yr)							
	1	2	3	4	5	6	7	9
258,971	2,112	0	0	0	0	0	0	256,859

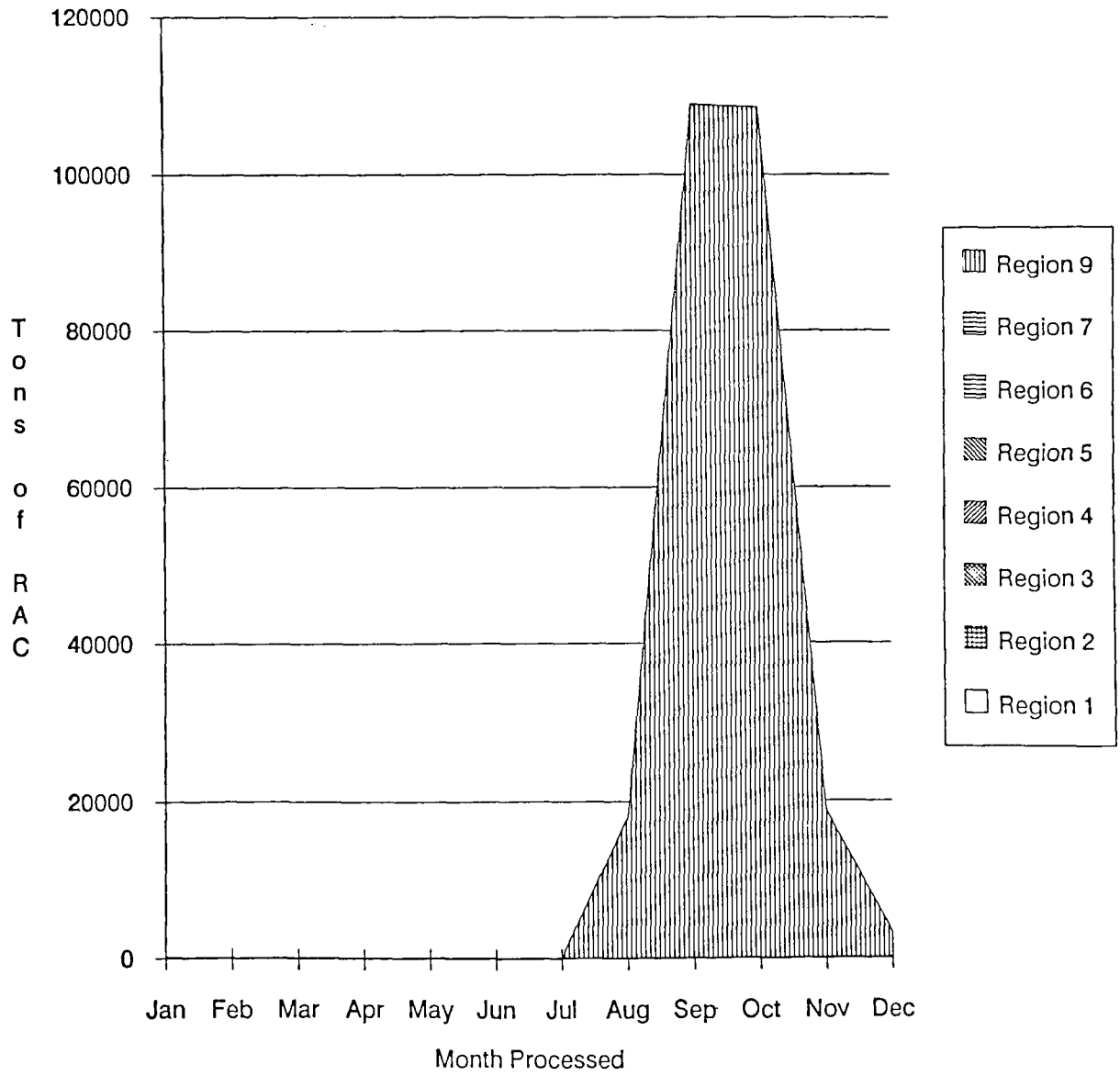


FIGURE A1. Processing Volume (tons/year) - Almonds

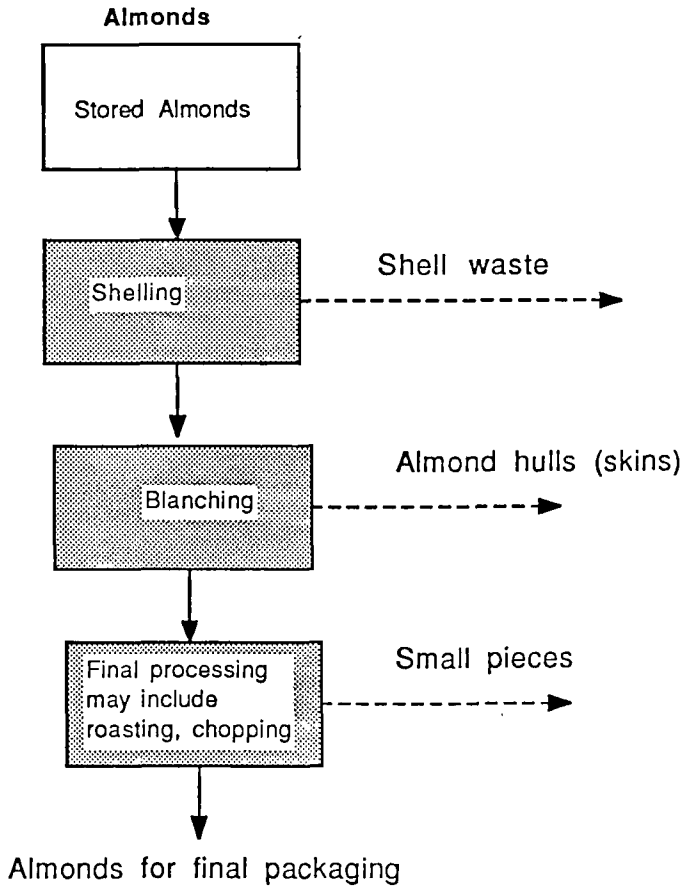


FIGURE A2. RAC Processing Flowsheet for Almonds

COMMODITY: Apples - includes crabapples

PRODUCTS MADE: Apple and mixed fruit juices and juice concentrates; applesauce; canned apple slices; cider vinegar

ANIMALS FED: Dairy and beef cattle; hogs

PORTIONS FED: Pomace (sometimes includes filter aids); culls; peels; cores.

TABLE A3. RAC Utilization Profile for Apples

	Moisture Content (wt%)				RAC Utilization (see note a)			
Disposition	Min	Max	Mean	σ	Weight	Min	Max	Mean
RAC	80.0	89.0	84.2	2.4	177,431	370	45,820	16,130
Food Product	80.0	89.0	84.6	2.7	121,472	7%	100%	68%
Wet Feed	80.0	85.0	82.8	1.8	26,516	0%	37%	15%
Dry Feed	n.r.	n.r.	n.r.	n.r.	0	0%	0%	0%
Land Applied	83.0	89.0	86.0	2.4	5,350	0%	91%	3%
Land Filled	80.0	86.0	83.0	2.1	5,479	0%	100%	3%
Burned	n.r.	n.r.	n.r.	n.r.	0	0%	0%	0%
Other					7,944	0%	25%	4%
Unaccounted for				-	10,670			6%

note (a): Values are in wt% of total RAC, except RAC and weight figures, which are in total tons/year.
n.r. indicates that data was not reported by survey respondents.
() around data value indicates a negative mass balance error.

Processing Practices

The primary product reported by survey respondents was apple juice concentrate, which is made from whole crushed apples including cores, peels, and some leaves/stems. Principal byproducts are the pomace (typically 75-85 wt% m.c.) which is mechanically screened and pressed to remove residual juice. Some stem/leaf waste is also produced, although this is a relatively small portion of the fruit waste. The stem/leaf waste is generally removed in the washing step. Applesauce is prepared from washed, cored, peeled apples, with the core and stems and peel material making up the solid byproduct stream. Peels are removed either mechanically (ie, by abrasion) or chemically (caustic peeling). Culls and trim material from grading/inspection lines are also treated as a byproduct. In some instances, this material is used as a feedstock for the production of vinegar.

Notes and Comments

The wide range of utilization rates is due to the mix of juice and applesauce processors. Apple juice processors generally have lower utilization rates. Unaccounted material is assumed to be moisture losses.

TABLE A4. Reported Processing Volume (tons/year) for Apples

Total Vol (tons/yr)	Processing Volume in Survey Region (tons RAC/yr)							
	1	2	3	4	5	6	7	9
177,431	0	20,000	1,208	30,443	9,180	0	68,398	48,202

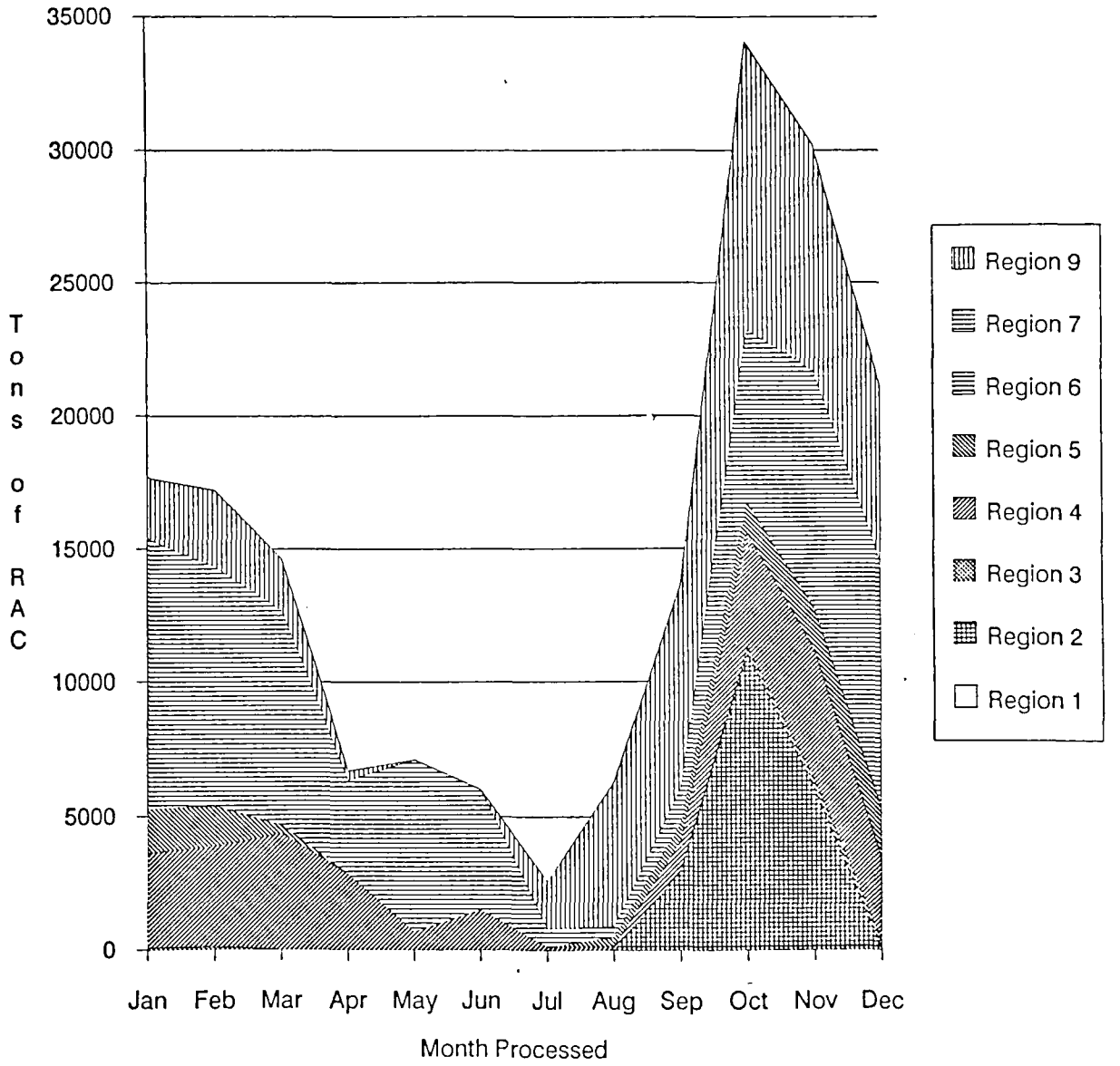


FIGURE A3. Processing Volume (tons/year) - Apples

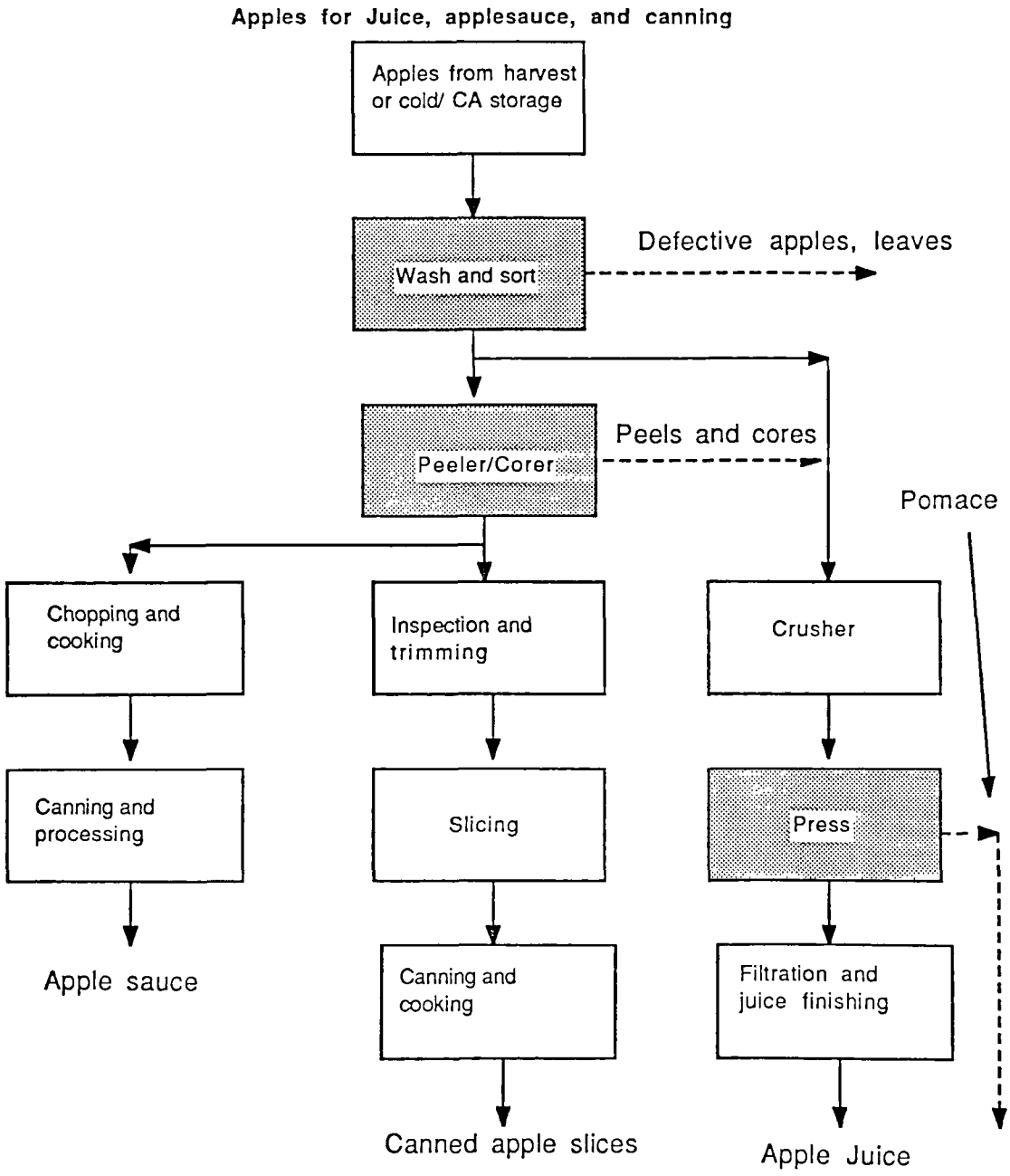


FIGURE A4. RAC Processing Flowsheet for Apples

COMMODITY: Berries (includes Strawberries, raspberries, blackberries, boysenberries, gooseberries, blueberries, cranberries).

PRODUCTS MADE: Primarily canned and frozen berries and puree; wine.

ANIMALS FED: Beef cattle.

PORTIONS FED: Pomace, culls

TABLE A5. RAC Utilization Profile for Berries

	Moisture Content (wt%)				RAC Utilization (see note a)			
Disposition	Min	Max	Mean	σ	Weight	Min	Max	Mean
RAC	80.0	92.0	86.2	3.7	29,429	2	7,200	1,839
Food Product	80.0	92.0	85.8	3.9	23,646	35%	99%	80%
Wet Feed	80.0	92.0	85.6	4.5	1,271	0%	11%	4%
Dry Feed	n.r.	n.r.	n.r.	n.r.	0	0%	0%	0%
Land Applied	80.0	80.0	80.0	0.0	589	0%	20%	2%
Land Filled	80.0	90.0	85.0	5.0	2,790	0%	100%	9%
Burned	n.r.	n.r.	n.r.	n.r.	0	0%	0%	0%
Other			-		1,143	0%	63%	4%
Unaccounted for		-			(9)			0%

note (a): Values are in wt% of total RAC, except RAC and weight figures, which are in total tons/year.
n.r. indicates that data was not reported by survey respondents.
() around data value indicates a negative mass balance error

Processing Notes

Incoming berries are water-washed, dewatered, generally frozen either in bulk or IQF. Most berries are processed as soon as possible after harvest; cranberries are stored frozen and processed year-round. Cranberries are generally canned as cranberry cocktail or IQF berries, or pressed and processed to juice.

TABLE A6. Reported Processing Volume (tons/year) for Berries

Total Vol (tons/yr)	Processing Volume in Survey Region (tons RAC/yr)							
	1	2	3	4	5	6	7	9
29,429	6,002	4,909	0	0	130	0	5,613	12,775

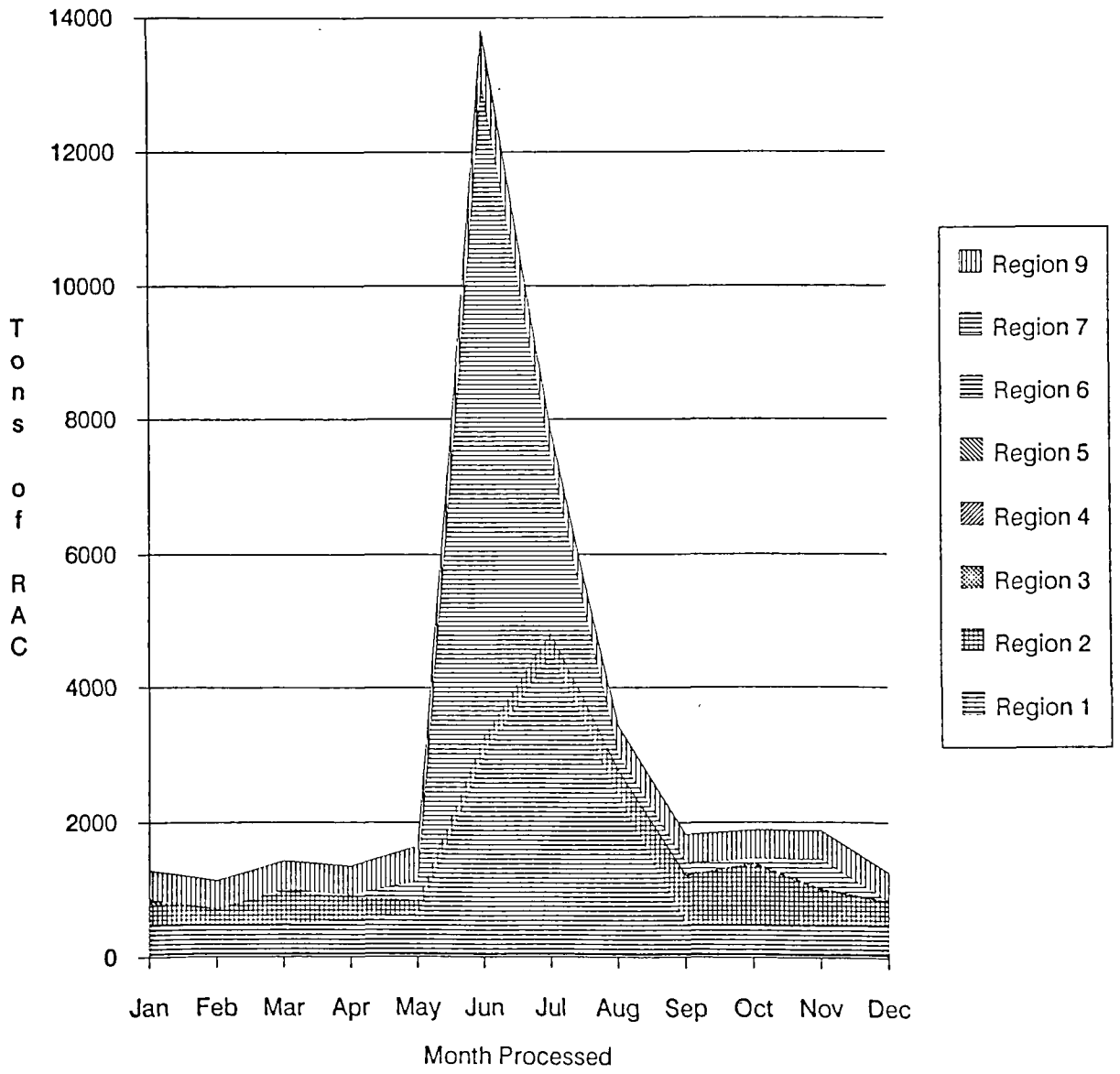


FIGURE A5. Processing Volume (tons/year) - Berries

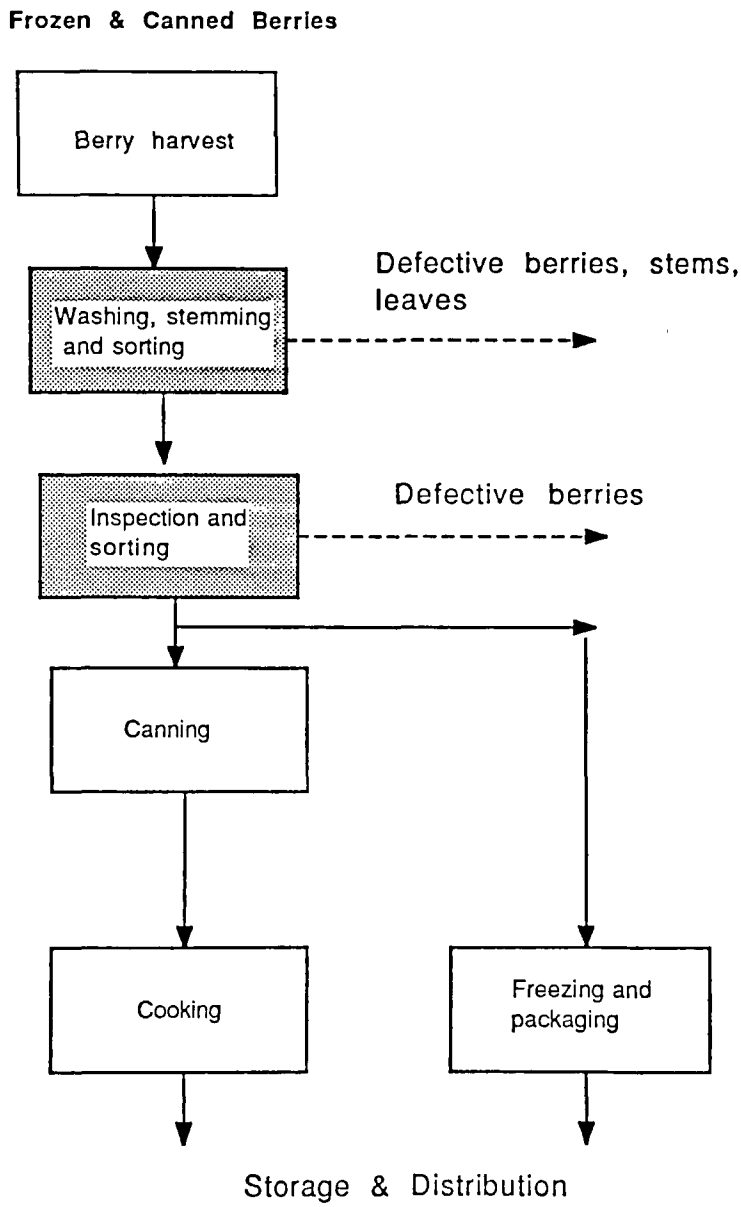


FIGURE A6. RAC Processing Flowsheet for Berries

COMMODITY: Cabbage (both red and white cabbage included).

PRODUCTS MADE: Red cabbage is canned or sold as uncooked, packaged shredded cabbage. It is pickled and used in Oriental specialty products. White cabbage is used in sauerkraut or frozen and shredded.

ANIMALS FED: Cattle and hogs.

PORTIONS FED: Outer leaves and culled heads are the primary byproduct but cores are also fed.

TABLE A7. RAC Utilization Profile for Cabbage

	Moisture Content (wt%)				RAC Utilization (see note a)			
Disposition	Min	Max	Mean	σ	Weight	Min	Max	Mean
RAC	80.0	95.0	89.0	4.3	72,615	75	12,385	5,586
Food Product	80.0	95.0	87.2	5.0	53,121	63%	95%	73%
Wet Feed	90.0	90.0	90.0	0.0	2,801	0%	30%	4%
Dry Feed	n.r.	n.r.	n.r.	n.r.	0	0%	0%	0%
Land Applied	0.0	95.0	61.6	40.5	13,727	0%	37%	19%
Land Filled	90.0	90.0	90.0	0.0	2,769	0%	100%	4%
Burned	n.r.	n.r.	n.r.	n.r.	0	0%	0%	0%
Other	-				198	0%	7%	0%
Unaccounted for					(0)	-		0%

note (a): Values are in wt% of total RAC, except RAC and weight figures, which are in total tons/year.
n.r. indicates that data was not reported by survey respondents.
() around data value indicates a negative mass balance error.

Processing Notes

Incoming cabbage is washed, hand-sorted and trimmed to remove defective outer leaves. The heads may also be cored prior to further processing (ie, to facilitate shredding). The main byproduct is defective heads and leaves.

Notes and Comments

Processing of white cabbage to produce sauerkraut appears to have somewhat different byproduct handling practices than processing of red cabbage; however, both varieties were combined to prevent disclosure of proprietary information. In general, land application of waste leaves and heads was more widespread in processing of white cabbage than red.

TABLE A8. Reported Processing Volume (tons/year) for Cabbage

Total Vol (tons/yr)	Processing Volume in Survey Region (tons RAC/yr)							
	1	2	3	4	5	6	7	9
72,615	950	55,011	0	16,654	0	0	0	0

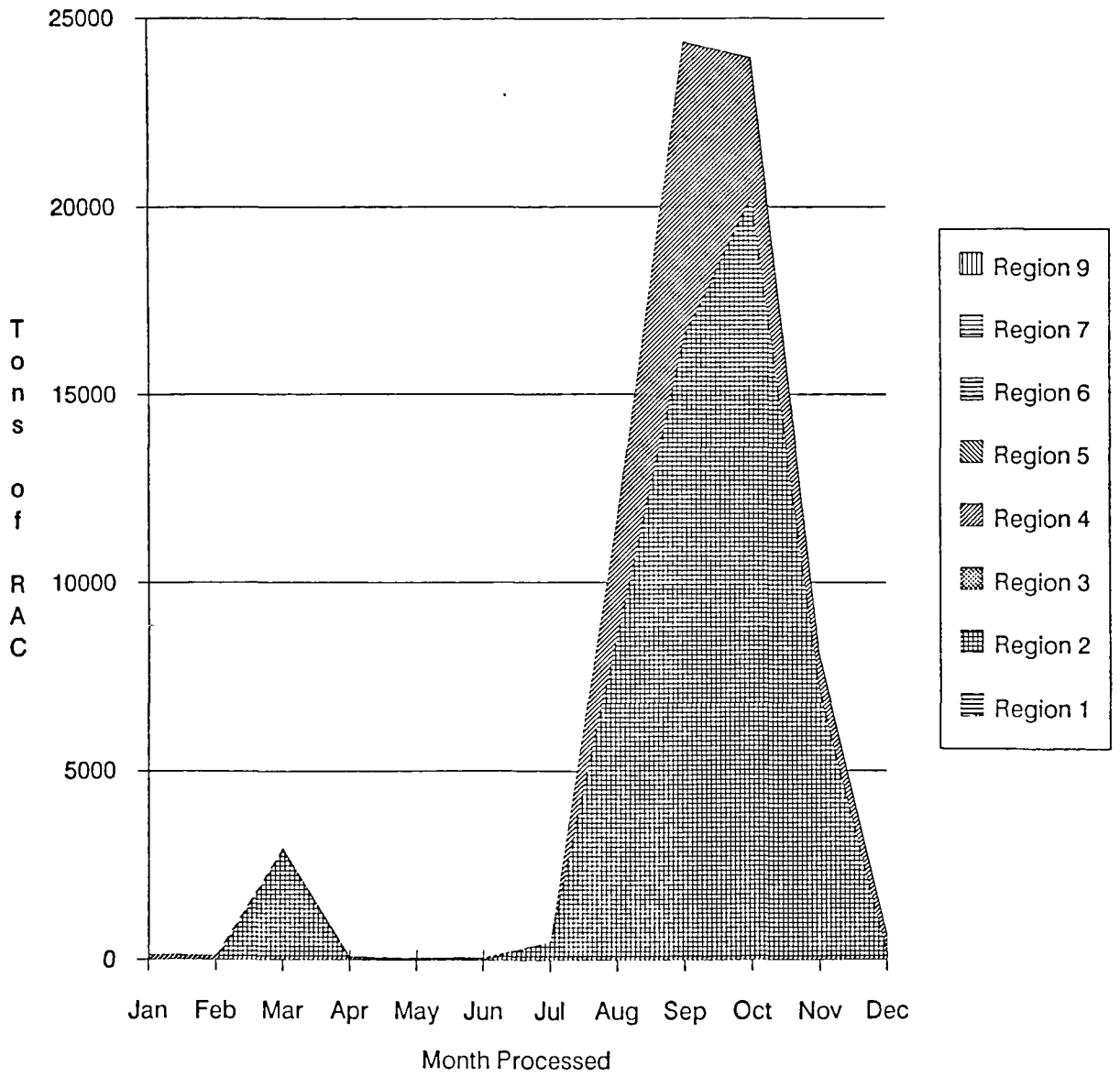


FIGURE A7. Processing Volume (tons/year) - Cabbage

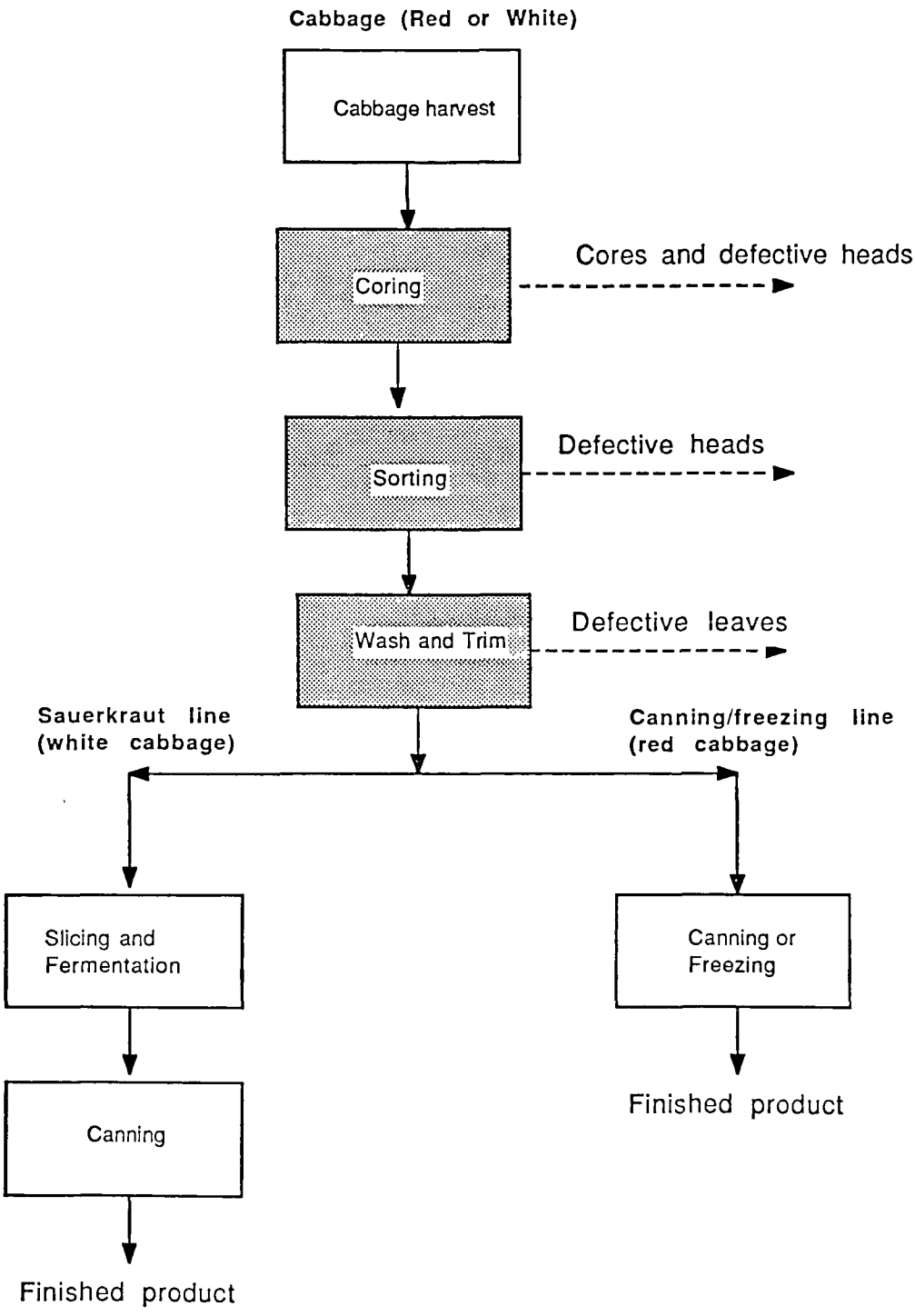


FIGURE A8. RAC Processing Flowsheet for Cabbage

COMMODITY: Carrots

PRODUCTS MADE: Frozen and canned whole and diced/sliced carrots; carrot puree; infant food; specialty sauces; carrot and mixed vegetable juice.

ANIMALS FED: Beef and dairy cattle; hogs; sheep; goats.

PORTIONS FED: Crowns; peels, culls, spillage; pulp (from juice).

TABLE A9. RAC Utilization Profile for Carrots

	Moisture Content (wt%)				RAC Utilization (see note a)			
Disposition	Min	Max	Mean	σ	Weight	Min	Max	Mean
RAC	60.0	91.0	82.3	11.1	118,344	81	19,000	5,635
Food Product	60.0	90.0	84.1	9.9	55,032	32%	94%	47%
Wet Feed	60.0	88.0	83.2	10.4	46,990	0%	67%	40%
Dry Feed	n.r.	n.r	n.r.	n.r.	0	0%	0%	0%
Land Applied	60.0	88.0	74.0	14.0	1,859	0%	60%	2%
Land Filled	67.0	67.0	67.0	0.0	1,599	0%	100%	1%
Burned	n.r.	n.r.	n.r.	n.r.	804	0%	59%	1%
Other	-		-		11,904	0%	54%	10%
Unaccounted for			-		155			0%

note (a): Values are in wt% of total RAC, except RAC and weight figures, which are in total tons/year
n.r. indicates that data was not reported by survey respondents.
() around data value indicates a negative mass balance error.

Processing Notes

Carrots are washed, blanched, and peeled prior to canning operations. Byproducts include off-grade carrots, crowns, peels, and pulp; small pieces from cutting operations may be land applied or mixed with other wastes. The peels may include some abrasive material (an artifact of the mechanical peeler). Dirt, small stones, and other foreign material may be present in small quantities, but is usually removed in the washing step. At least one processor reported that carrot peel/pulp was being burned, presumably as fuel.

TABLE A10. Reported Processing Volume (tons/year) for Carrots

Total Vol (tons/yr)	Processing Volume in Survey Region (tons RAC/yr)							
	1	2	3	4	5	6	7	9
118,344	0	1,539	0	31,587	18,699	0	44,677	21,842

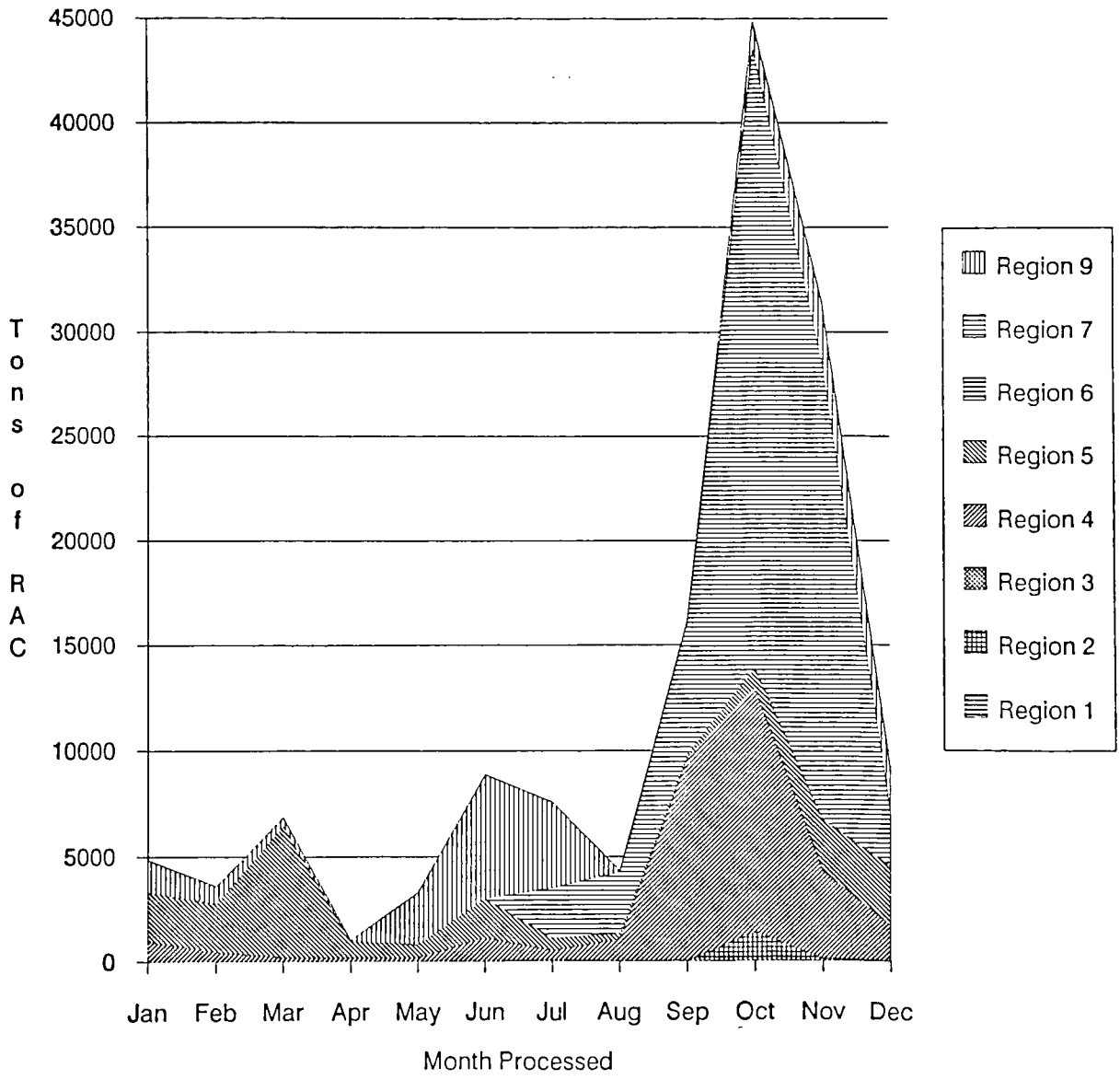


FIGURE A9. Processing Volume (tons/year) - Carrots

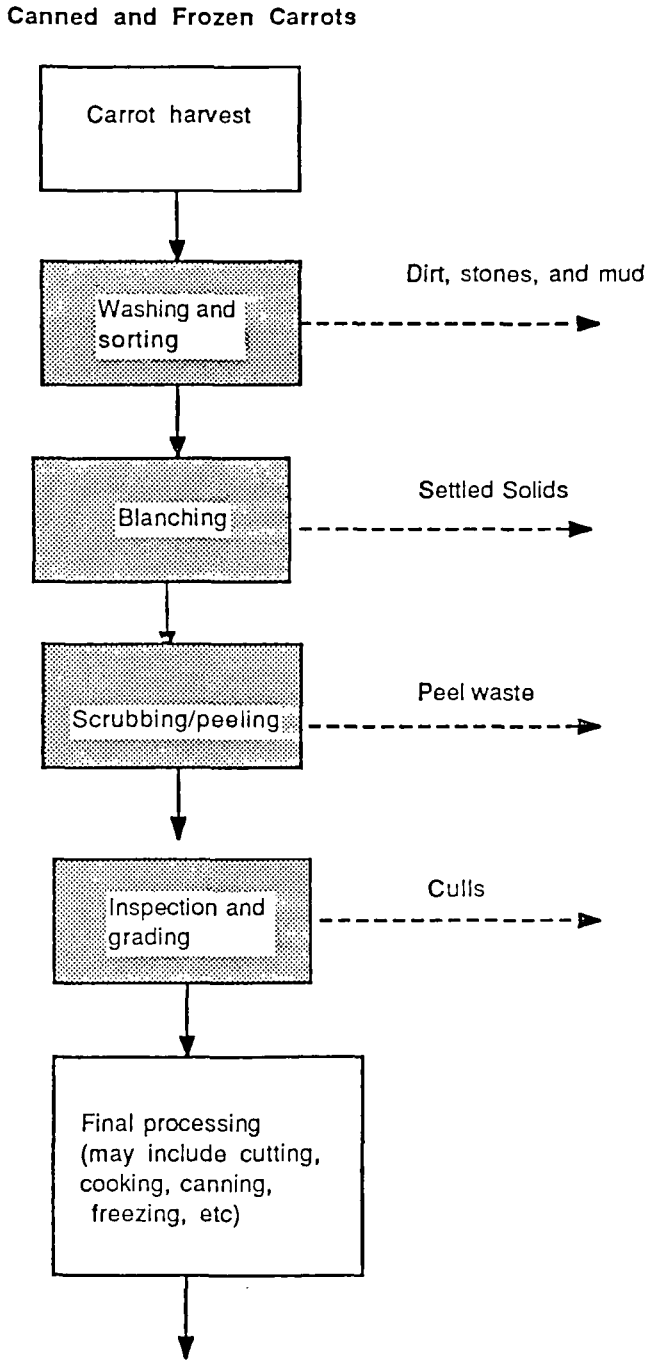


FIGURE A10. RAC Processing Flowsheet for Carrots

COMMODITY: Cherries (includes both sweet and sour cherries)

PRODUCTS MADE: Canned and/or cherry products; brined cherries.

ANIMALS FED: Not specified

PORTIONS FED: Cull cherries, pits, stems.

TABLE A11. RAC Utilization Profile for Cherries

	Moisture Content (wt%)				RAC Utilization (see note a)			
Disposition	Min	Max	Mean	σ	Weight	Min	Max	Mean
RAC	60.0	95.0	81.0	7.7	22,234	85	7,464	1,390
Food Product	60.0	95.0	80.9	8.0	16,638	62%	100%	75%
Wet Feed	80.4	80.4	80.4	n.r.	552	0%	22%	2%
Dry Feed	n.r.	n.r.	n.r.	n.r.	0	0%	0%	0%
Land Applied	80.0	80.0	80.0	0.0	1,928	0%	26%	9%
Land Filled	60.0	95.0	80.1	10.2	1,553	0%	100%	7%
Burned	n.r.	n.r	n.r.	n.r.	271	0%	12%	1%
Other					1,291	0%	20%	6%
Unaccounted for			-		0			0%

note (a): Values are in wt% of total RAC, except RAC and weight figures, which are in total tons/year.
n.r. indicates that data was not reported by survey respondents.
() around data value indicates a negative mass balance error.

Processing Notes

Incoming cherries are soaked in cool water to firm the fruit, sorted and graded both mechanically and visually, and then pitted. The pitted cherries may be canned, frozen by IQF methods, made into puree, or brined. In each case, the principal waste stream is derived from the upstream processes, particularly the pitting operation. The pits are landfilled (where permitted), or crushed and land applied. They are also be burned as a fuel. Only one processor reported feeding the pits (along with the cull cherries and stems) as cattle feed.

TABLE A12. Reported Processing Volume (tons/year) for Cherries

Total Vol (tons/yr)	Processing Volume in Survey Region (tons RAC/yr)							
	1	2	3	4	5	6	7	9
22,234	Ø	Ø	Ø	3,ØØØ	85	214	14,23Ø	4,7Ø5

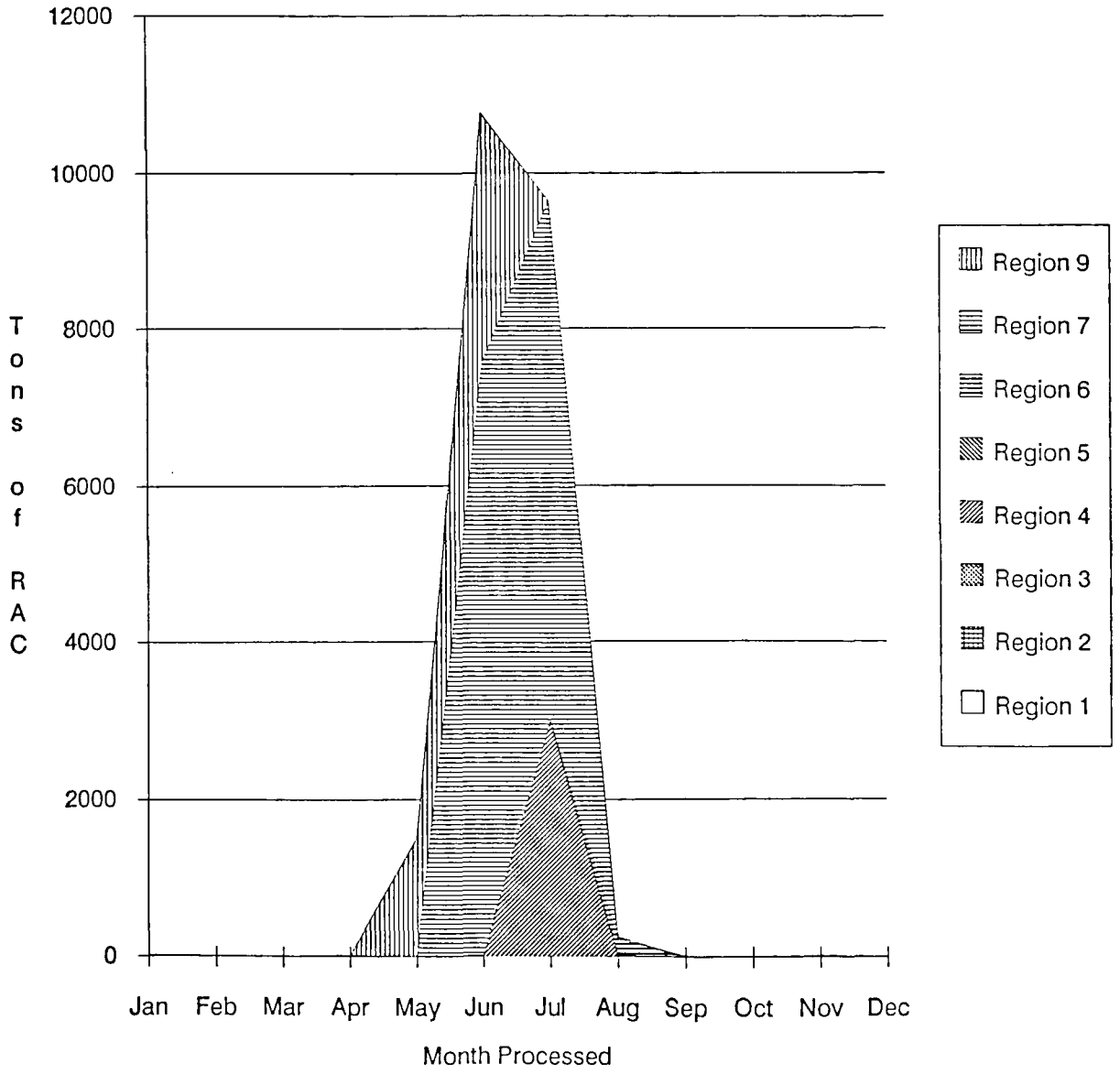


FIGURE A11. Processing Volume (tons/year) - Cherries

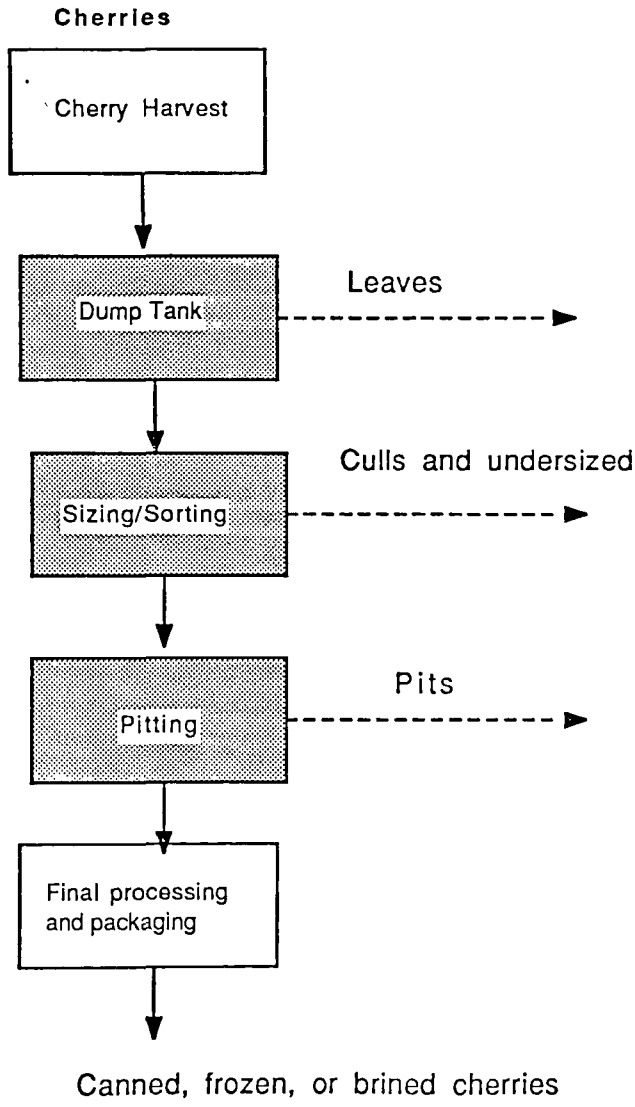


FIGURE A12. RAC Processing Flowsheet for Cherries

COMMODITY: Citrus (includes oranges, lemons, grapefruit and limes).

PRODUCTS MADE: Frozen juice concentrate; peel and essences.

ANIMALS FED: Dairy and beef cattle.

PORTIONS FED: Pulp (from juice pressing operation) and peel (from mechanical peeler).

TABLE A13. RAC Utilization Profile for Citrus Fruit

	Moisture Content (wt%)				RAC Utilization (see note a)			
Disposition	Min	Max	Mean	σ	Weight	Min	Max	Mean
RAC	40.0	95.0	75.3	21.6	839,512	112	360,000	83,951
Food Product	0.0	95.0	65.9	32.1	128,020	7%	93%	15%
Wet Feed	0.0	75.0	40.0	30.8	73,251	0%	55%	9%
Dry Feed	0.0	95.0	61.2	43.3	67,298	0%	26%	8%
Land Applied	n.r.	n.r.	n.r.	n.r.	0	0%	0%	0%
Land Filled	n.r.	n.r.	n.r.	n.r.	1,600	0%	100%	0%
Burned	n.r.	n.r.	n.r.	n.r.	0	0%	0%	0%
Other	-				1,164	0%	60%	0%
Unaccounted for	-	-		-	568,180			68%

note (a): Values are in wt% of total RAC, except RAC and weight figures, which are in total tons/year.
n.r. indicates that data was not reported by survey respondents.
() around data value indicates a negative mass balance error.

Processing Notes

Incoming fruit is washed and residual twigs, leaves and stems are removed prior to grading. Graded whole or halved oranges are individually pressed to remove the juice, which is then further processed prior to packaging as a frozen concentrate or canned ready-to-drink juice. The wastes from the pressing device contains the membrane material (pulp), seeds, and residual juice; the peel is generally removed as a separate byproduct stream. The pulp is dried (11.6 wt% m.c.) prior to its use as a cattle feed. The peel is processed to recover essential oils and flavorings, along with minor co-products including pectin. Residual peel waste (53 wt% m.c.) is also fed to cattle. The large amount of unaccounted for material is due to the failure to report moisture losses during juice concentration.

TABLE A14. Reported Processing Volume (tons/year) for Citrus

Total Vol (tons/yr)	Processing Volume in Survey Region (tons RAC/yr)							
	1	2	3	4	5	6	7	9
839,512	0	0	656,778	0	19,399	0	0	163,336

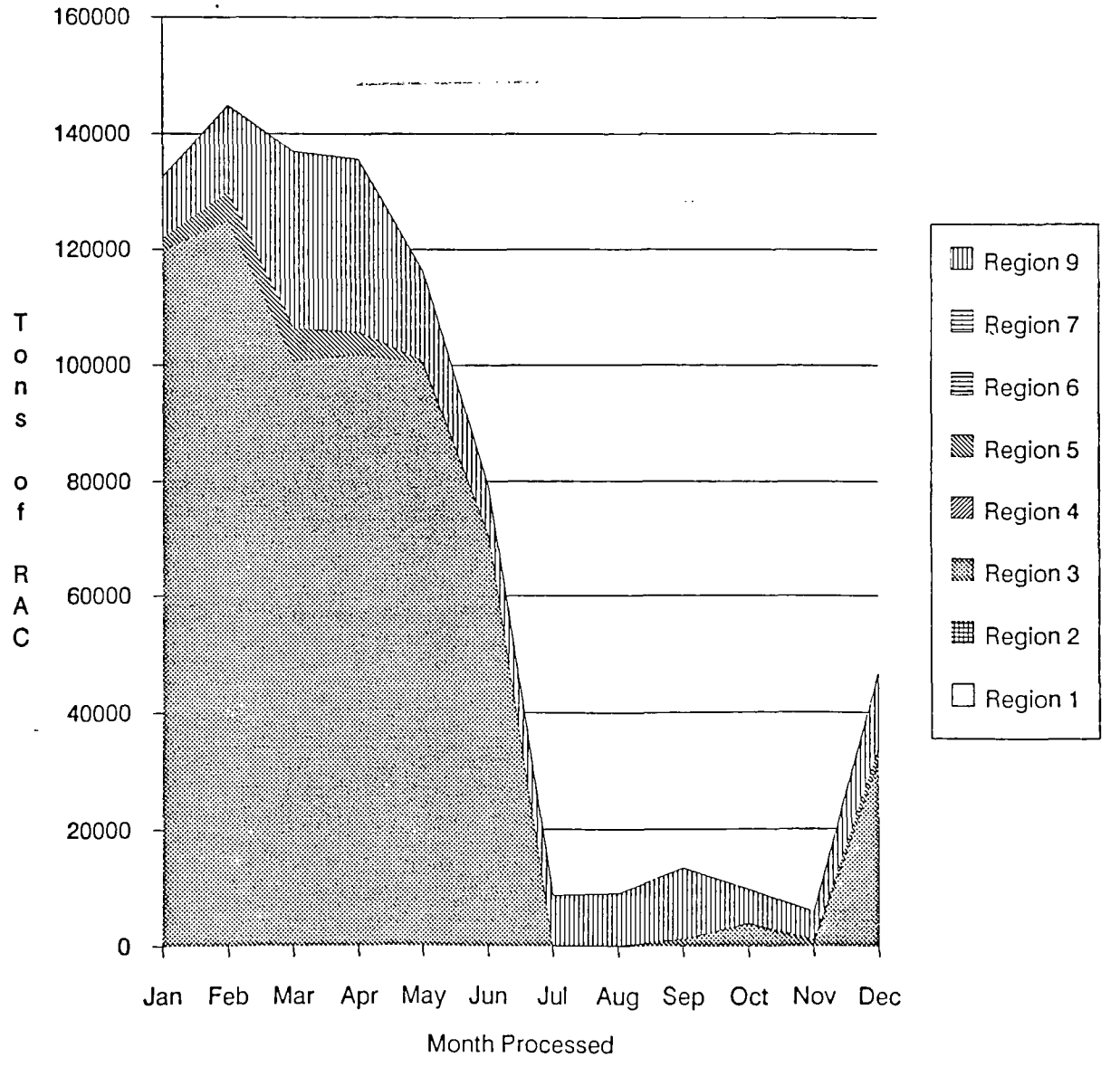


FIGURE A13. Processing Volume (tons/year) - Citrus

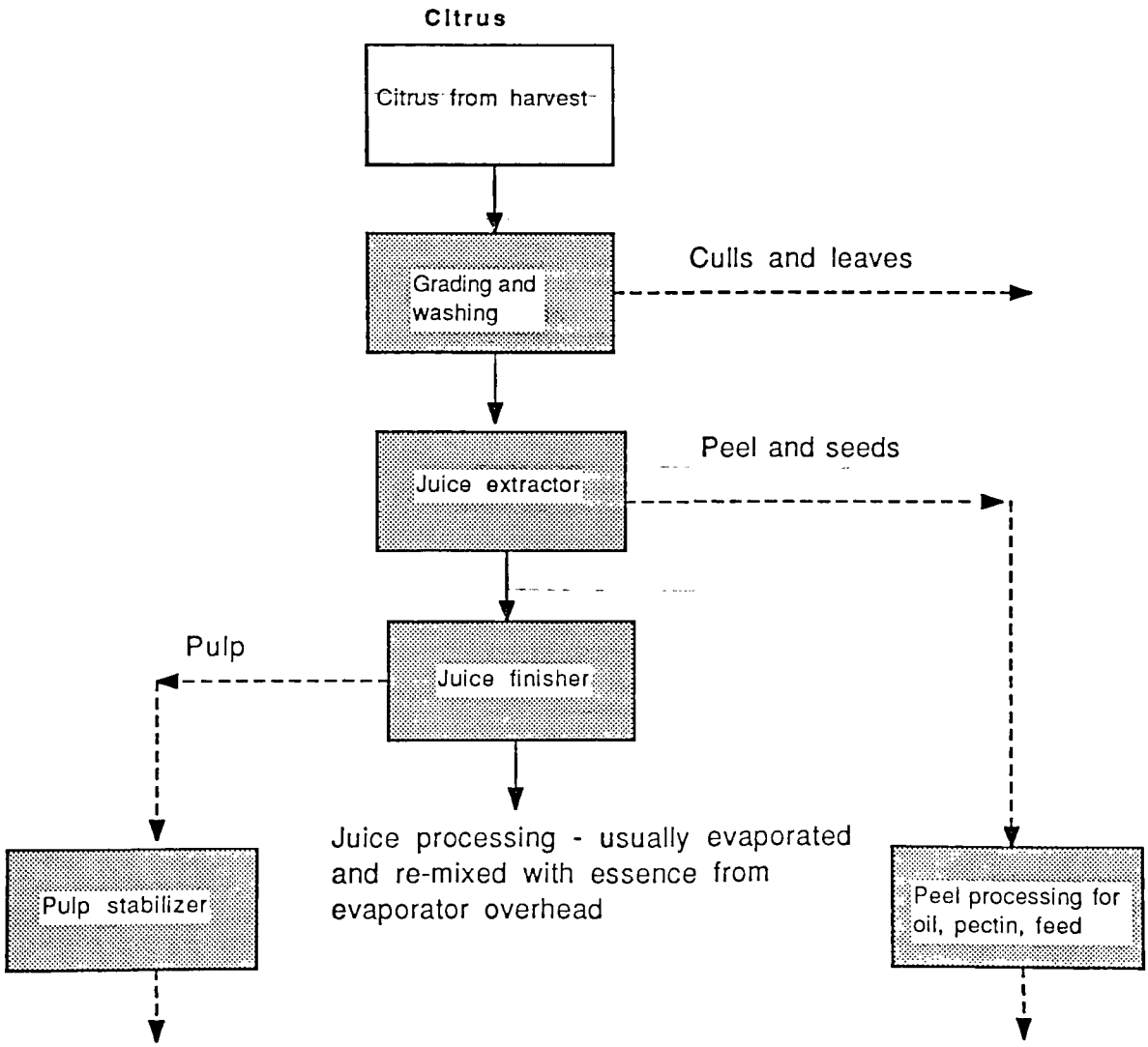


FIGURE A14 RAC Processing Flowsheet for Citrus Fruit

COMMODITY: Coffee

PRODUCTS MADE: Roasted and ground coffee beans

ANIMALS FED: None.

PORTIONS FED: NA

TABLE A15. RAC Utilization Profile for Coffee

	Moisture Content (wt%)				RAC Utilization (see note a)			
Disposition	Min	Max	Mean	σ	Weight	Min	Max	Mean
RAC	3.0	20.0	14.6	7.0	65,405	2,061	31,608	13,081
Food Product	10.0	20.0	17.5	4.3	58,565	85%	100%	90%
Wet Feed	n.r.	n.r.	n.r.	n.r.	0	0%	0%	0%
Dry Feed	n.r.	n.r.	n.r.	n.r.	0	0%	0%	0%
Land Applied	n.r.	n.r.	n.r.	n.r.	0	0%	0%	0%
Land Filled	n.r.	n.r.	n.r.	n.r.	95	0%	100%	0%
Burned	n.r.	n.r.	n.r	n.r.	0	0%	0%	0%
Other					6,745	0%	15%	10%
Unaccounted for				-	(0)	-		0%

note (a): Values are in wt% of total RAC, except RAC and weight figures, which are in total tons/year.
n.r. indicates that data was not reported by survey respondents.
() around data value indicates a negative mass balance error.

Processing Notes

Green coffee beans are roasted to remove moisture and bring out the characteristic flavor of the coffee. Solid wastes are limited to dust and spillage from bean transfer operations.

TABLE A16. Reported Processing Volume (tons/year) for Coffee

Total Vol (tons/yr)	Processing Volume in Survey Region (tons RAC/yr)							
	1	2	3	4	5	6	7	9
65,405	0	15,236	2,061	16,500	0	0	0	31,608

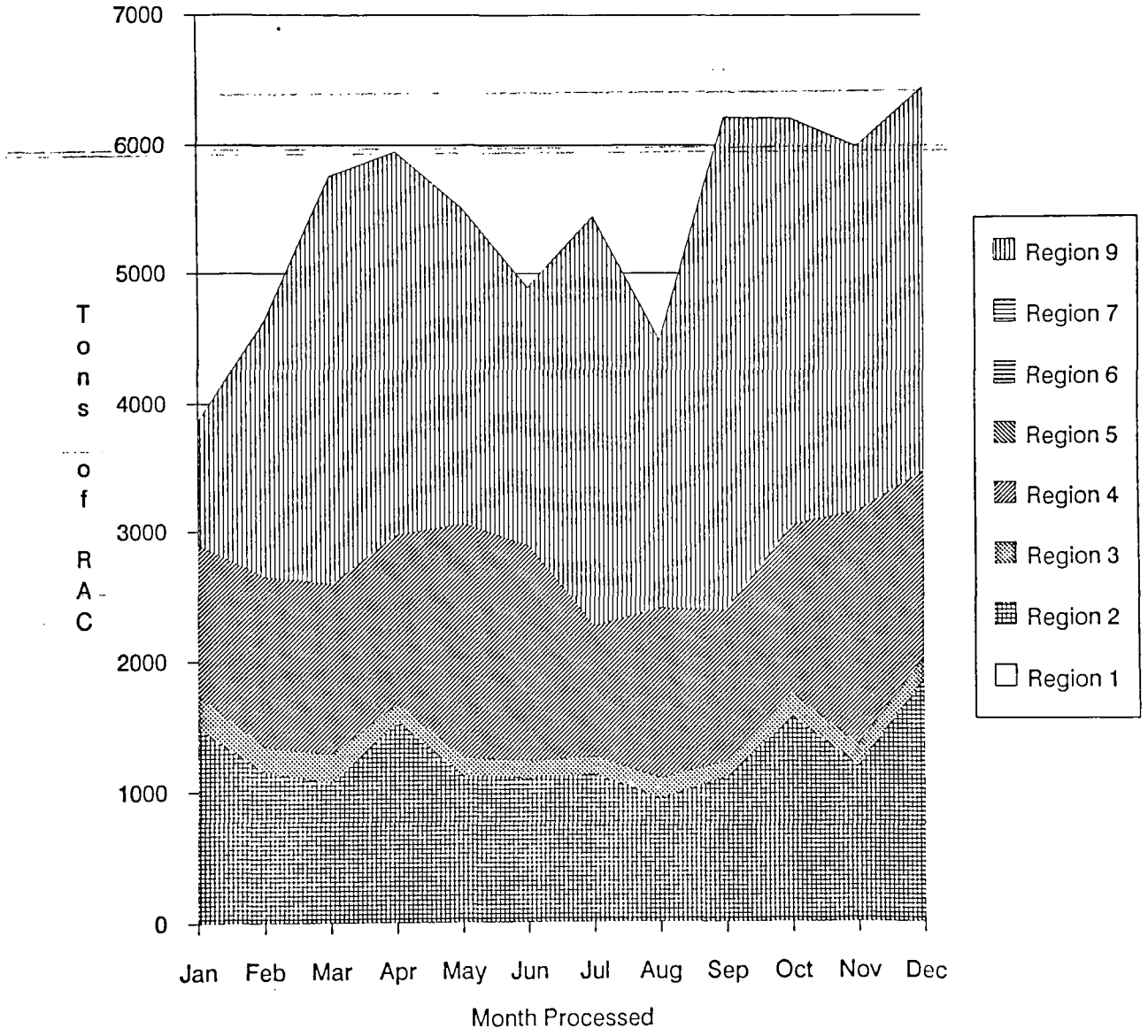


FIGURE A15 Processing Volume (tons/year) - Coffee

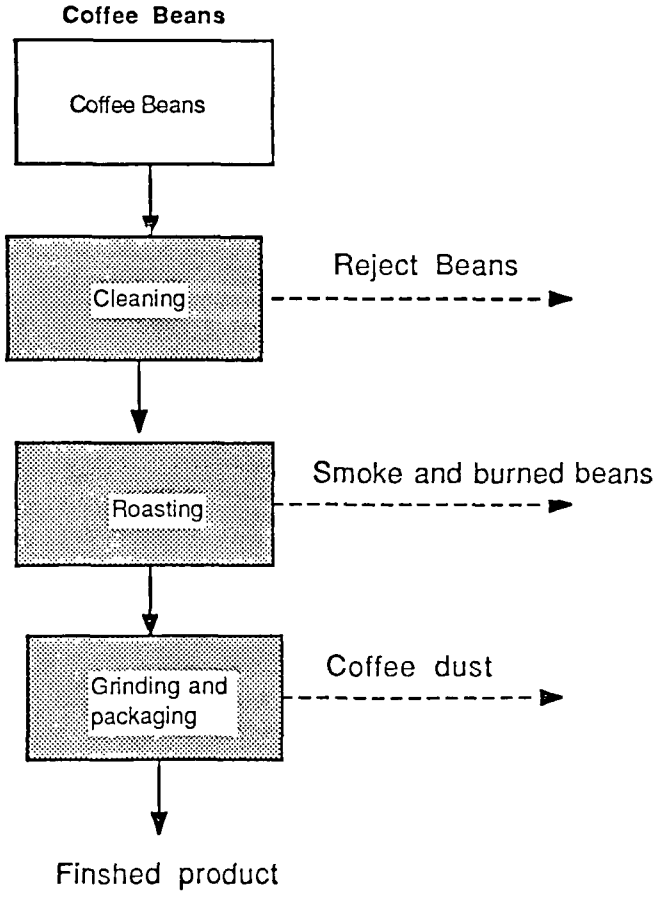


FIGURE A16. RAC Processing Flowsheet for Coffee

COMMODITY: Cottonseed

PRODUCTS MADE: Crude and refined cottonseed oil.

ANIMALS FED: Dairy and beef cattle; hogs.

PORTIONS FED: Extracted meal and hulls.

TABLE A17. RAC Utilization Profile for Cottonseed

	Moisture Content (wt%)				RAC Utilization (see note a)			
Disposition	Min	Max	Mean	σ	Weight	Min	Max	Mean
RAC	8.5	12.0	9.9	1.1	1,036,662	28,127	192,000	129,583
Food Product	0.0	0.0	0.0	0.0	170,325	14%	18%	16%
Wet Feed	8.5	12.0	10.3	1.8	112,527	0%	69%	11%
Dry Feed	0.0	10.6	8.2	3.4	600,725	0%	76%	58%
Land Applied	n.r.	n.r.	n.r.	n.r.	0	0%	0%	0%
Land Filled	9.5	9.5	9.5	0.0	8,475	0%	100%	1%
Burned	n.r.	n.r.	n.r.	n.r.	0	0%	0%	0%
Other					126,391	0%	34%	12%
Unaccounted for		-			18,219			2%

note (a): Values are in wt% of total RAC, except RAC and weight figures, which are in total tons/year.
n.r. indicates that data was not reported by survey respondents.
() around data value indicates a negative mass balance error.

Processing Notes

After removal of the cotton fibers, cottonseed is sent to a cottonseed mill for oil extraction. There, they are air scalped to remove dirt and other field trash (9 wt% m.c.) The raw seeds are stripped of the remaining fibers ("linters") in 1-3 passes. The seeds are then de-hulled to remove the tough outer covering from the seed. The dehulled seed is then pressed through a roller mill to produce a flake which can be more readily extracted. Extraction is typically by solvent (hexane) although mechanical methods are also used. The primary byproducts are the hulls and the desolventized meal, which are generally fed (10 wt% m.c.). The linters have commercial value as a source of low grade cellulose fibers.

TABLE A18. Reported Processing Volume (tons/year) for Cottonseed

Total Vol (tons/yr)	Processing Volume in Survey Region (tons RAC/yr)							
	1	2	3	4	5	6	7	9
1,036,662	0	0	0	0	891,062	0	0	145,600

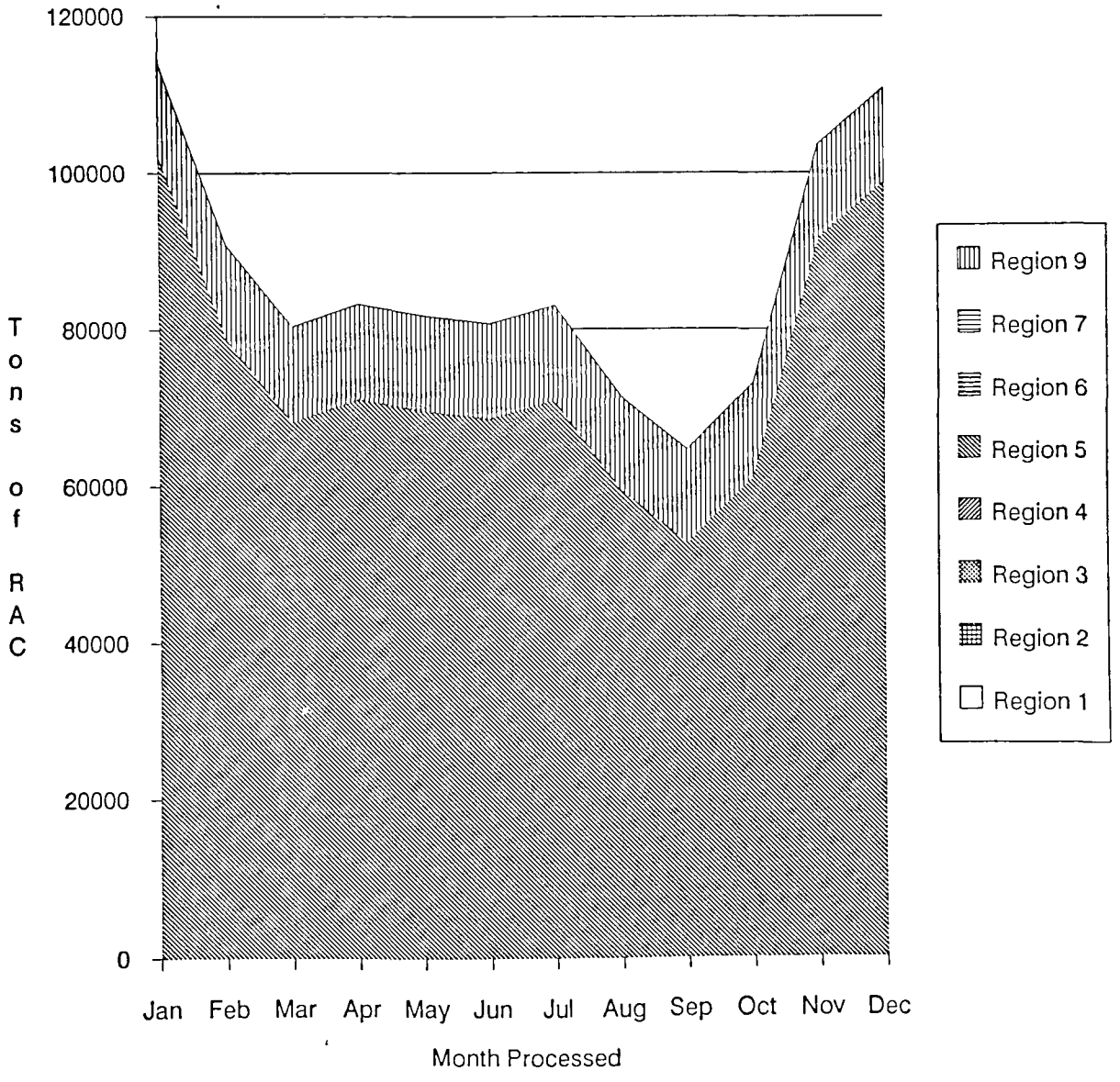


FIGURE A17. Processing Volume (tons/year) - Cottonseed

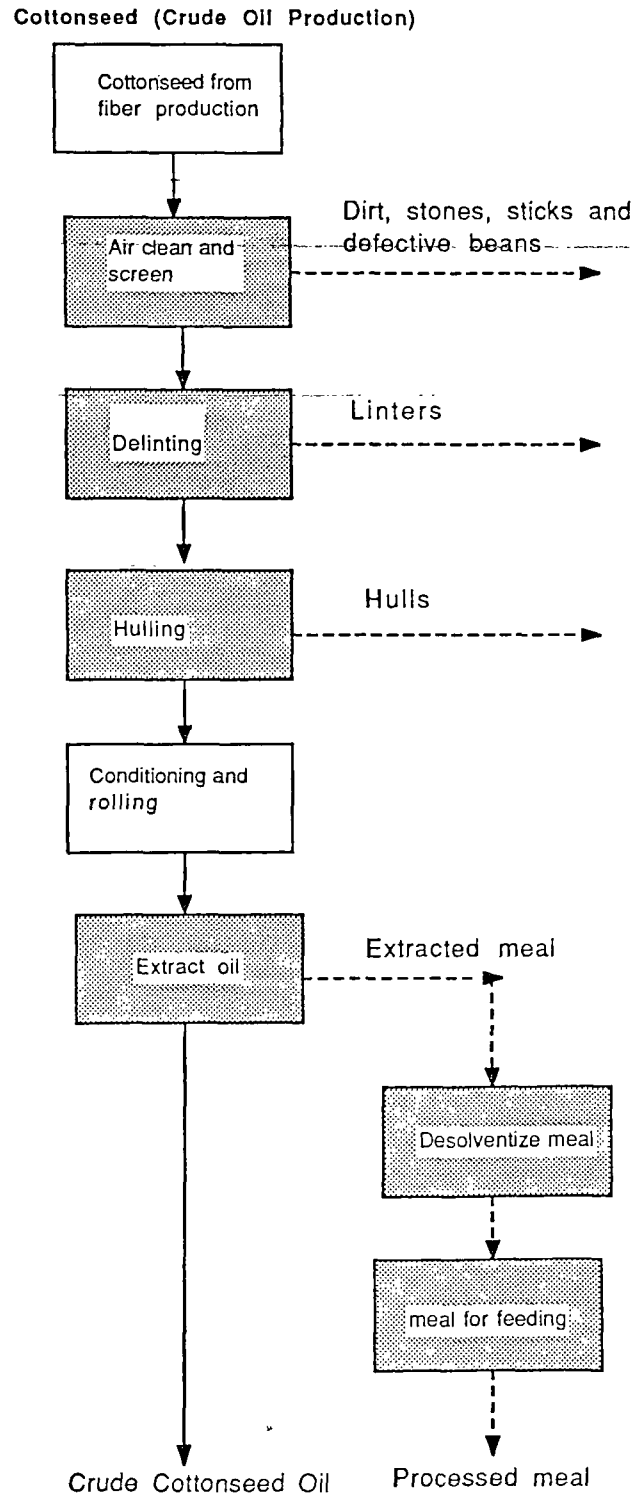


FIGURE A18. RAC Processing Flowsheet for Cottonseed

COMMODITY: Cucumbers

PRODUCTS MADE: Pickles

ANIMALS FED: None.

PORTIONS FED: NA

TABLE A19. RAC Utilization Profile for Cucumbers

	Moisture Content (wt%)				RAC Utilization (see note a)			
Disposition	Min	Max	Mean	σ	Weight	Min	Max	Mean
RAC	85.0	95.0	90.0	5.0	18,815	6,940	11,875	9,408
Food Product	85.0	85.0	85.0	0.0	18,001	90%	99%	96%
Wet Feed	n.r.	n.r.	n.r.	n.r.	0	0%	0%	0%
Dry Feed	n.r.	n.r.	n.r.	n.r.	0	0%	0%	0%
Land Applied	n.r.	n.r.	n.r.	n.r.	0	0%	0%	0%
Land Filled	85.0	85.0	85.0	0.0	694	0%	100%	4%
Burned	n.r.	n.r.	n.r.	n.r.	0	0%	0%	0%
Other					0	0%	0%	0%
Unaccounted for					120			1%

note (a): Values are in wt% of total RAC, except RAC and weight figures, which are in total tons/year
n.r. indicates that data was not reported by survey respondents.
() around data value indicates a negative mass balance error.

Processing Notes

The small amount of waste reported for cucumbers is primarily off-grade material not suitable for pickling. The only reported end-use of this waste was land filling.

TABLE A20. Reported Processing Volume (tons/year) for Cucumbers

Total Vol (tons/yr)	Processing Volume in Survey Region (tons RAC/yr)							
	1	2	3	4	5	6	7	9
18,815	0	0	0	18,815	0	0	0	0

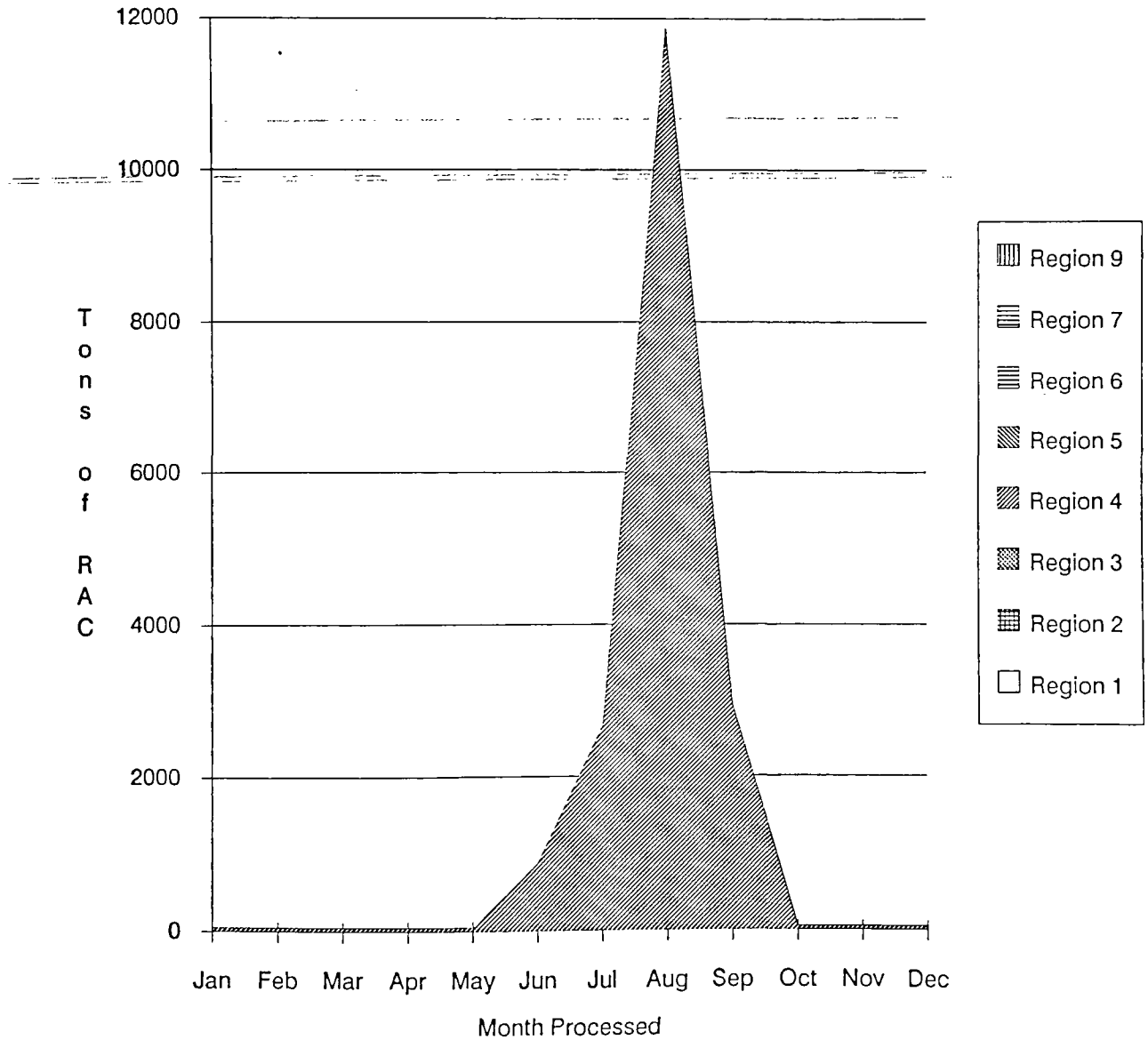


FIGURE A19. Processing Volume (tons/year) - Cucumbers

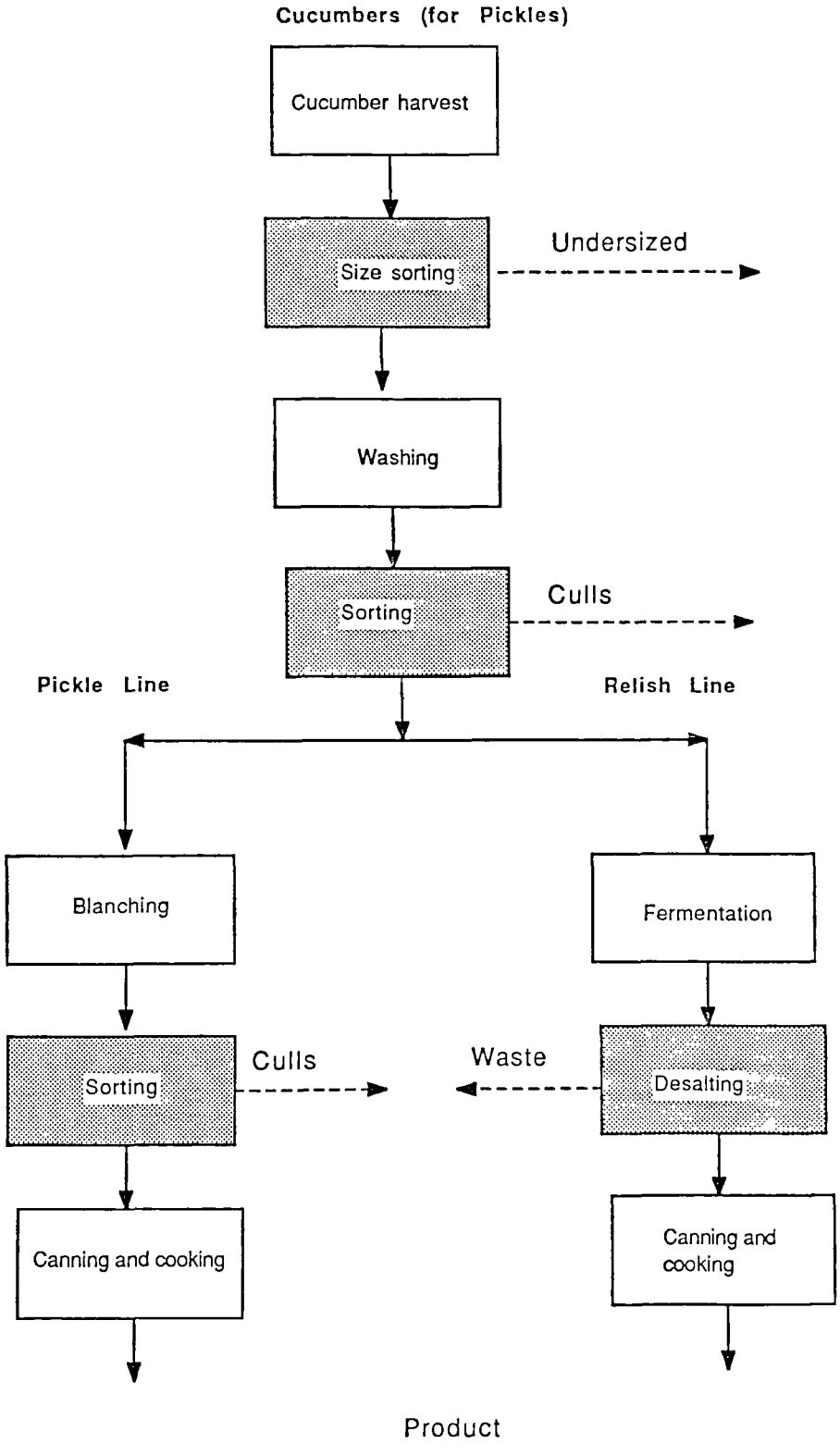


FIGURE A20. RAC Processing Flowsheet for Cucumbers

COMMODITY: Dried Beans and Peas

PRODUCTS MADE: Canned beans, dried beans and peas, specialty products.

ANIMALS FED: Hogs, cattle, poultry

PORTIONS FED: Split beans and other culls, leaves, bean chips.

TABLE A21. RAC Utilization Profile for Dried Beans and Peas

	Moisture Content (wt%)				RAC Utilization (see note a)			
Disposition	Min	Max	Mean	σ	Weight	Min	Max	Mean
RAC	3.0	93.0	15.5	13.0	133,288	8	15,000	3,418
Food Product	3.0	21.0	13.3	3.5	124,395	73%	100%	93%
Wet Feed	12.0	12.0	12.0	0.0	1,505	0%	27%	1%
Dry Feed	10.0	16.0	11.7	2.0	5,603	0%	20%	4%
Land Applied	12.0	21.0	15.3	2.6	838	0%	4%	1%
Land Filled	10.0	15.4	12.9	2.0	1,040	0%	100%	1%
Burned	n.r.	n.r.	n.r.	n.r	0	0%	0%	0%
Other	-				59	0%	0%	0%
Unaccounted for				-	(152)			0%

note (a): Values are in wt% of total RAC, except RAC and weight figures, which are in total tons/year.
n.r. indicates that data was not reported by survey respondents.
() around data value indicates a negative mass balance error.

Processing Notes

Incoming peas and beans are generally received free of foliage. A variety of methods are used to clean and sort the beans, including aspiration, air scalping, etc. The beans are then inspected, and may be cooked and filled (canned beans) or air dried (dry packaged beans). Byproducts are primarily derived from screening and cleaning operations. Some of this waste material (from primary cleaning operations) is landfilled since it is high in dirt content. The remainder is fed.

TABLE A22. Reported Processing Volume (tons/year) for Dry beans & Peas

Total Vol (tons/yr)	Processing Volume in Survey Region (tons RAC/yr)							
	1	2	3	4	5	6	7	9
133,288	200	269	9,284	25,933	31,015	15,000	23,128	28,459

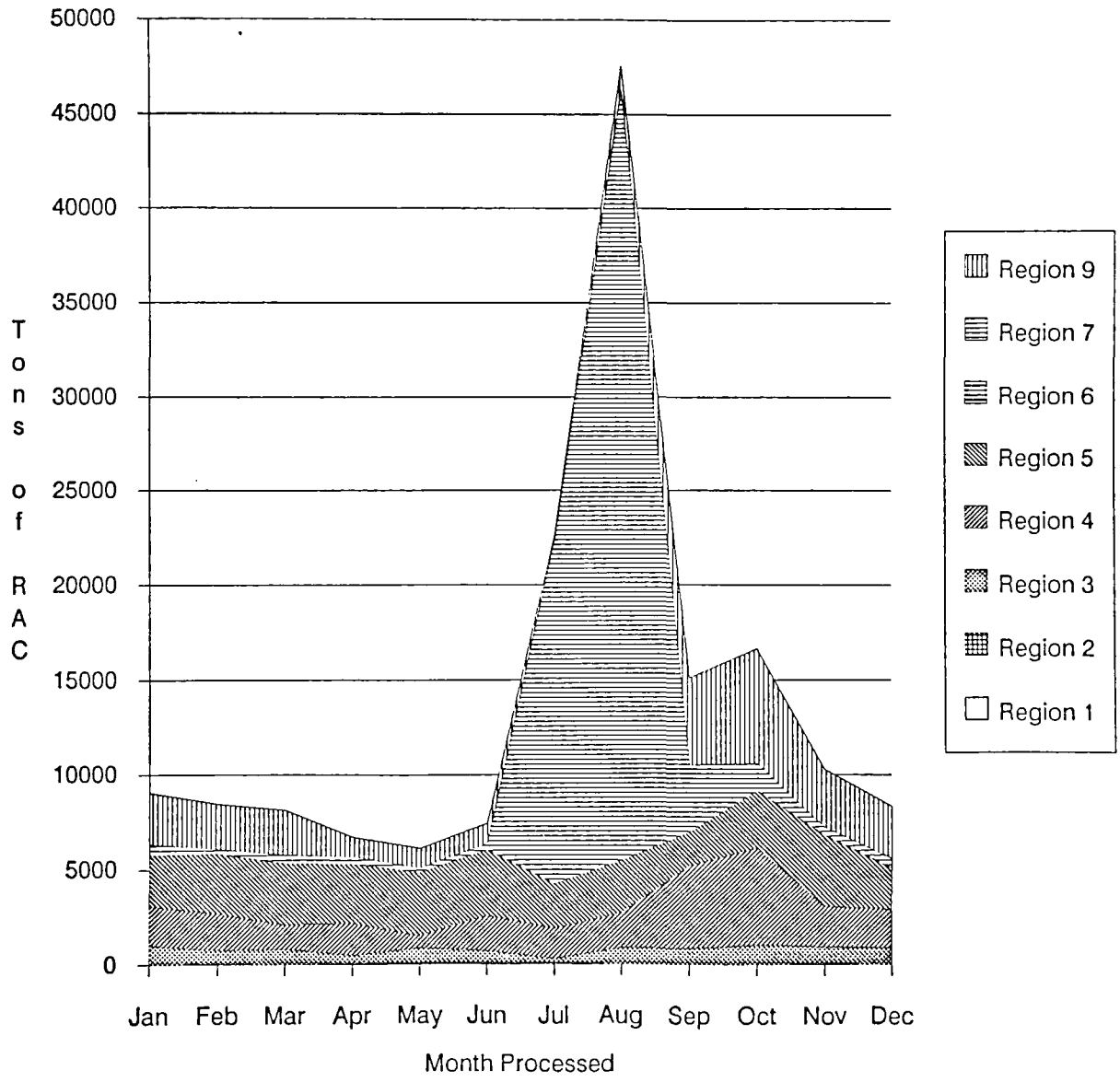


FIGURE A21. Processing Volume (tons/year) - Dry beans & peas

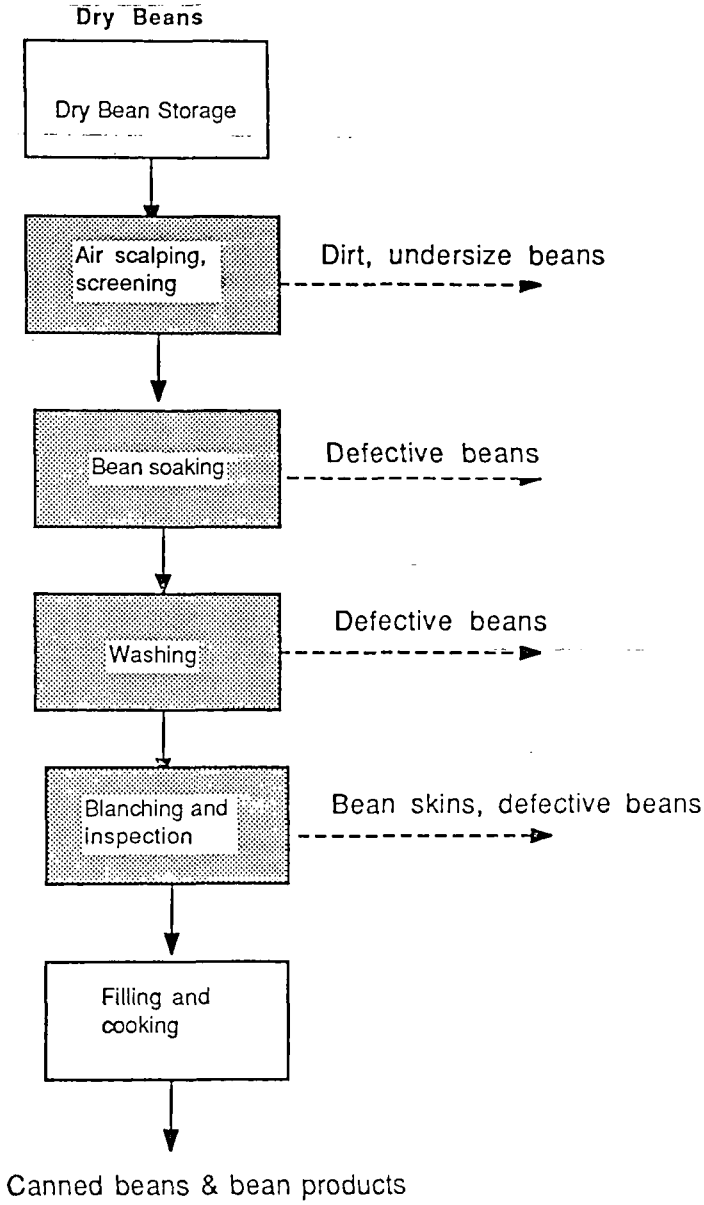


FIGURE A22. RAC Processing Flowsheet for Dried Beans and Peas

COMMODITY: Grapes

PRODUCTS MADE: Wine; grape spirits; grape juice; fruit cocktail.

ANIMALS FED: Grape solids tend to be high in tannic acids and do not make suitable feeding material. However, one processor reported feeding pomace to hogs.

PORTIONS FED: Pomace

TABLE A23. RAC Utilization Profile for Grapes

	Moisture Content (wt%)				RAC Utilization (see note a)			
Disposition	Min	Max	Mean	σ	Weight	Min	Max	Mean
RAC	64.0	90.0	81.1	6.3	170,001	7	65,124	8,500
Food Product	64.0	90.0	80.8	6.5	149,962	64%	97%	88%
Wet Feed	80.0	80.0	80.0	0.0	3,629	0%	6%	2%
Dry Feed	n.r.	n.r.	n.r.	n.r.	0	0%	0%	0%
Land Applied	75.0	90.0	81.1	4.3	10,748	0%	36%	6%
Land Filled	75.0	82.0	78.5	3.5	4,764	0%	100%	3%
Burned	n.r.	n.r.	n.r.	n.r.	0	0%	0%	0%
Other					864	0%	6%	1%
Unaccounted for					35			0%

note (a): Values are in wt% of total RAC, except RAC and weight figures, which are in total tons/year
n.r. indicates that data was not reported by survey respondents.
() around data value indicates a negative mass balance error.

Processing Notes

Depending on harvesting methods, grapes arrive for processing with some leaves and stems. Leave and stem waste is generally landfilled. Juice and wine making operations produce pomace, which may contain some filter aids such as rice hulls or paper. Small portions of other semi-solid wastes include tank sludge and lees, which were not reported in the survey but are universal to grape processing. These wastes are high in tartaric acid and generally landfilled.

Additional Comments

Grape processing is extremely seasonal, with the main processing season typically lasting slightly more than 30 days.

TABLE A24. Reported Processing Volume (tons/year) for Grapes

Total Vol (tons/yr)	Processing Volume in Survey Region (tons RAC/yr)							
	1	2	3	4	5	6	7	9
170,001	107	22,222	0	1,843	0	0	437	145,393

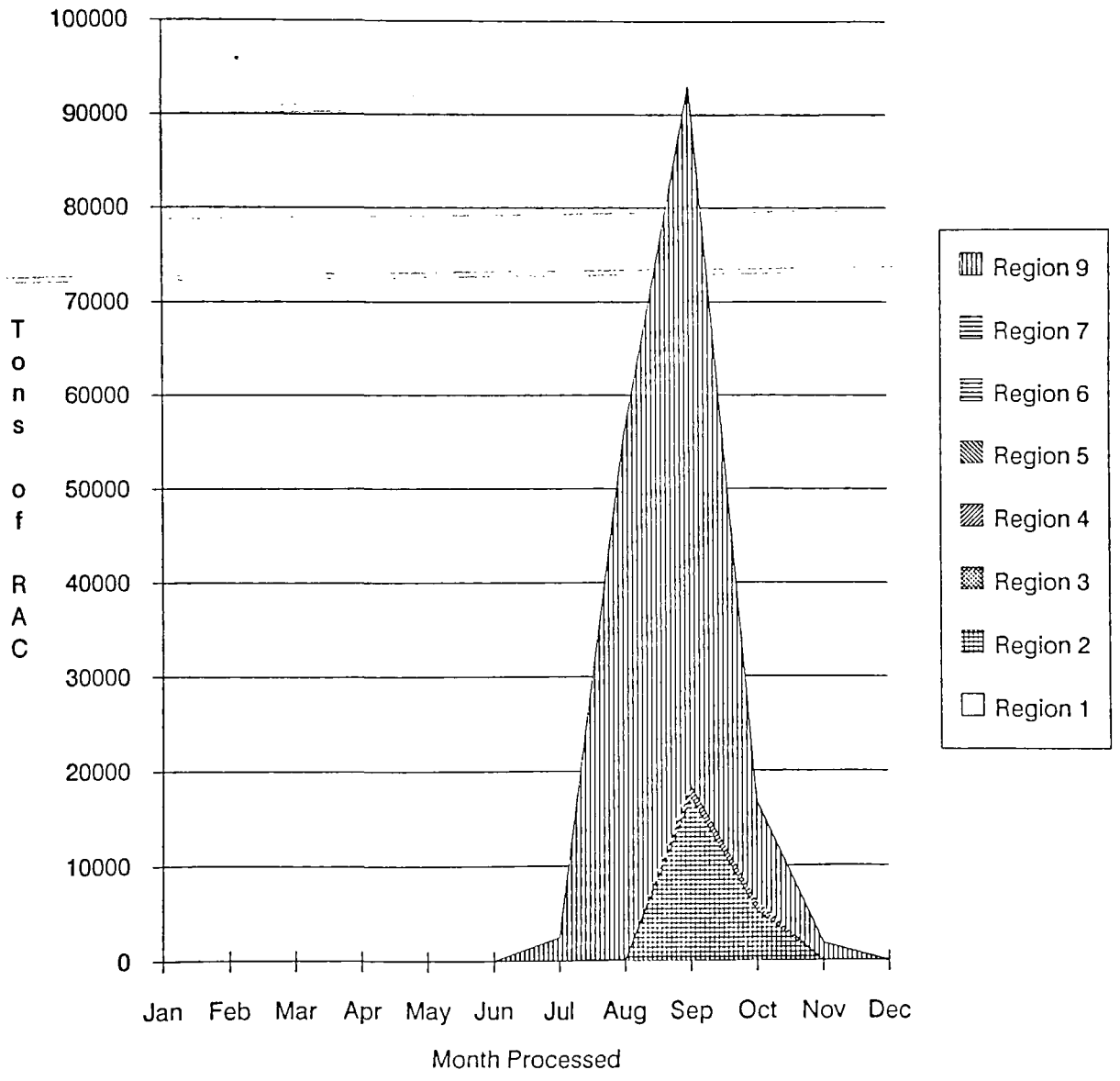


FIGURE A23. Processing Volume (tons/year) - Grapes

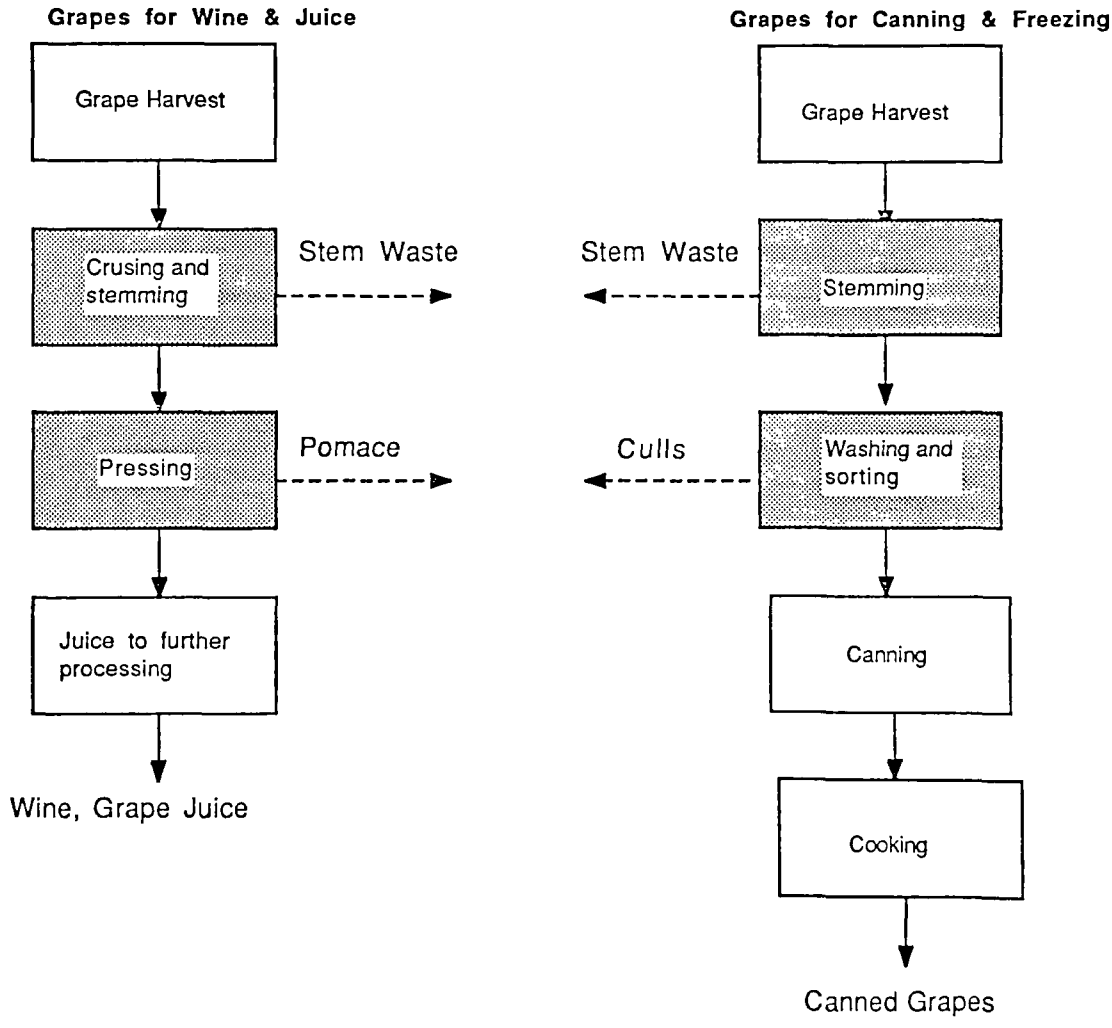


FIGURE A24. RAC Processing Flowsheet for Grapes

COMMODITY: Green beans (includes snap beans, wax beans)

PRODUCTS MADE: Canned and frozen beans

ANIMALS FED: Cattle, sheep, goats, hogs

PORTIONS FED: Off-size beans, culls, leaves/stems, weeds and snipped bean ends. Aggregate average m.c. is 85 wt%.

TABLE A25. RAC Utilization Profile for Green Beans

	Moisture Content (wt%)				RAC Utilization (see note a)			
Disposition	Min	Max	Mean	σ	Weight	Min	Max	Mean
RAC	80.0	93.0	88.6	3.9	210,071	83	48,004	11,056
Food Product	0.0	93.0	75.9	31.3	161,338	67%	100%	77%
Wet Feed	80.0	93.0	88.0	4.5	26,316	0%	31%	13%
Dry Feed	n.r.	n.r	n.r.	n.r.	0	0%	0%	0%
Land Applied	80.0	85.0	82.5	2.5	18,442	0%	27%	9%
Land Filled	n.r.	n.r.	n.r.	n.r.	1,775	0%	100%	1%
Burned	n.r.	n.r.	n.r.	n.r.	0	0%	0%	0%
Other					2,219	0%	15%	1%
Unaccounted for	-				(19)			0%

note (a): Values are in wt% of total RAC, except RAC and weight figures, which are in total tons/year.
n.r. indicates that data was not reported by survey respondents.
() around data value indicates a negative mass balance error.

Processing Notes

Harvested beans, including varying degrees of foliage, are air blown to remove loose leaves and dirt, washed, and cut from the vines with a cluster cutter. A second air scalping step removes undersized beans, and the remaining beans are washed again, end-snipped, inspected and graded. Following a final removal of any remaining stems, the beans are cut for packaging, and undersized cut pieces are removed. The beans are then blanched and packaged, either in cans or frozen. The wastes include the stem and leaf waste from the various cleaning steps, as well as culled beans and undersized beans and pieces.

TABLE A26. Reported Processing Volume (tons/year) for Green beans

Total Vol (tons/yr)	Processing Volume in Survey Region (tons RAC/yr)							
	1	2	3	4	5	6	7	9
210,071	0	25,168	83	127,610	11,020	0	46,190	0

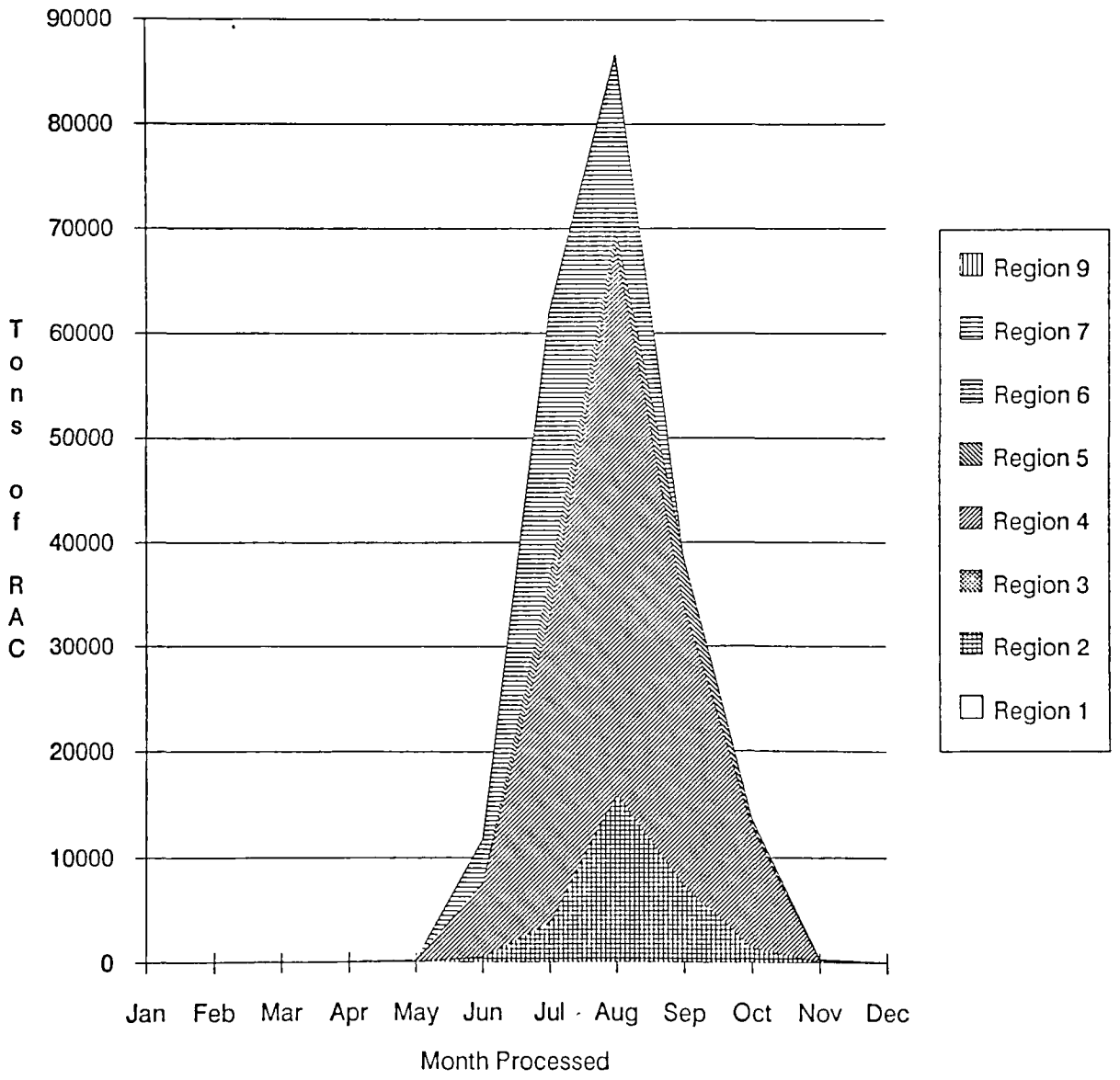


FIGURE A25. Processing Volume (tons/year) - Green beans

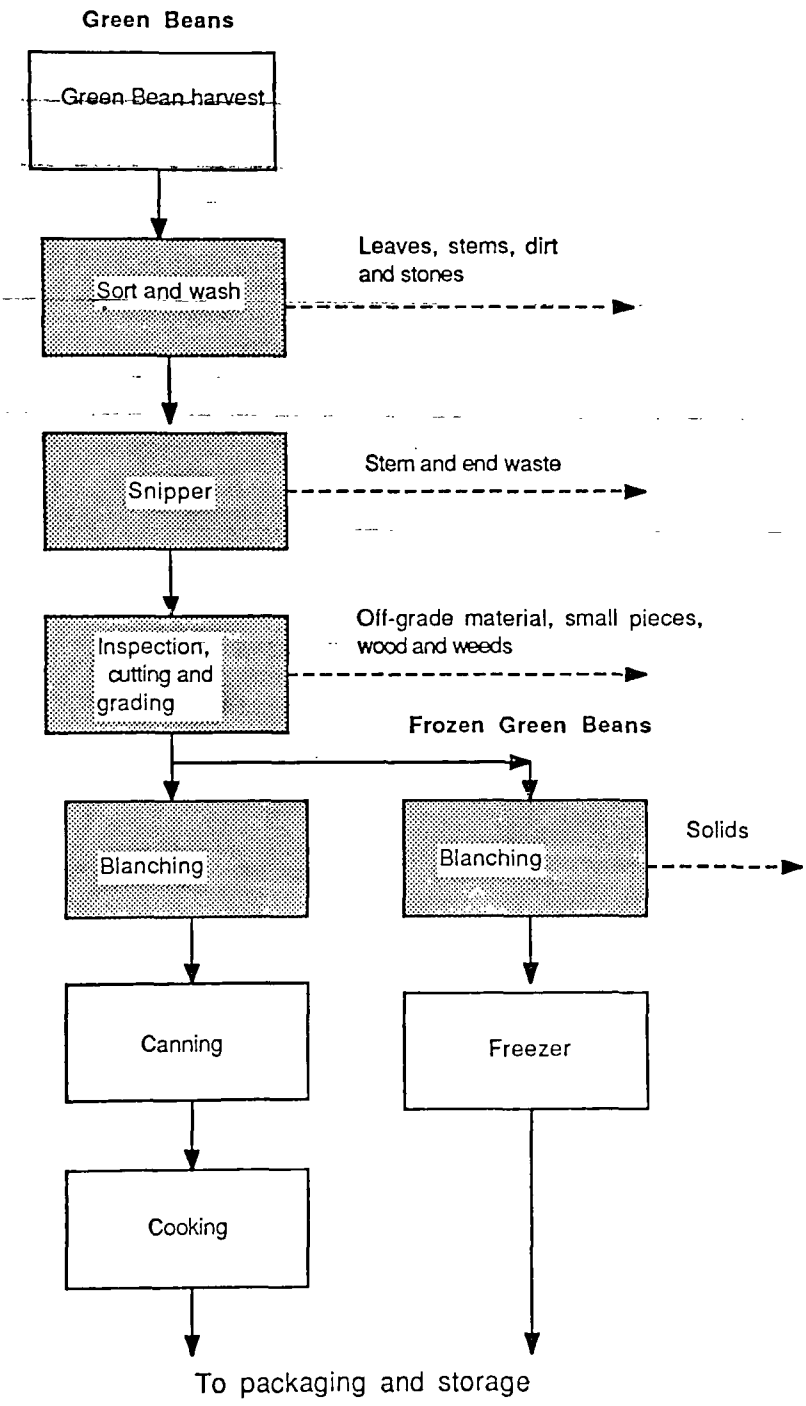


FIGURE A26. RAC Processing Flowsheet for Green Beans

COMMODITY: Green (sweet) peas (includes snow peas).

PRODUCTS MADE: Canned and IQF peas and vegetable mixtures.

ANIMALS FED: Beef cattle and hogs

PORTIONS FED: Pods, stems/leaves, culls, spillage.

TABLE A27. RAC Utilization Profile for Green Peas

	Moisture Content (wt%)				RAC Utilization (see note a)			
Disposition	Min	Max	Mean	σ	Weight	Min	Max	Mean
RAC	53.0	92.0	79.5	9.1	144,684	390	17,000	5,565
Food Product	0.0	92.0	67.8	30.3	126,641	76%	95%	88%
Wet Feed	0.0	90.0	66.1	33.3	16,495	0%	24%	11%
Dry Feed	n.r.	n.r.	n.r.	n.r.	0	0%	0%	0%
Land Applied	0.0	92.0	55.7	40.0	938	0%	20%	1%
Land Filled	n.r.	n.r.	n.r.	n.r.	0	0%	100%	0%
Burned	n.r.	n.r.	n.r.	n.r.	0	0%	0%	0%
Other	-	-	-		613	0%	3%	0%
Unaccounted for	-				(2)	-		0%

note (a): Values are in wt% of total RAC, except RAC and weight figures, which are in total tons/year.
n.r. indicates that data was not reported by survey respondents.
() around data value indicates a negative mass balance error.

Processing Notes

Harvested green peas (which may include pods and some stem/leaf waste) is air cleaned to remove trash and loose pea skins, washed, sorted and blanched. This may be followed by a second air cleaning to remove split peas and skins loosened by the blanching process, as well as a second, visual inspection. Waste from the washing, sorting, blanching and reinspection steps is often combined and is treated separately from the waste stream generated by the preliminary air cleaning.

Notes & Comments

Pea vines, pods, and stems are generally left in the field. Some of the in-plant wastes are also land applied.

TABLE A28. Reported Processing Volume (tons/year) for Green peas

Total Vol (tons/yr)	Processing Volume in Survey Region (tons RAC/yr)							
	1	2	3	4	5	6	7	9
144,684	Ø	1,605	Ø	101,228	Ø	Ø	41,851	Ø

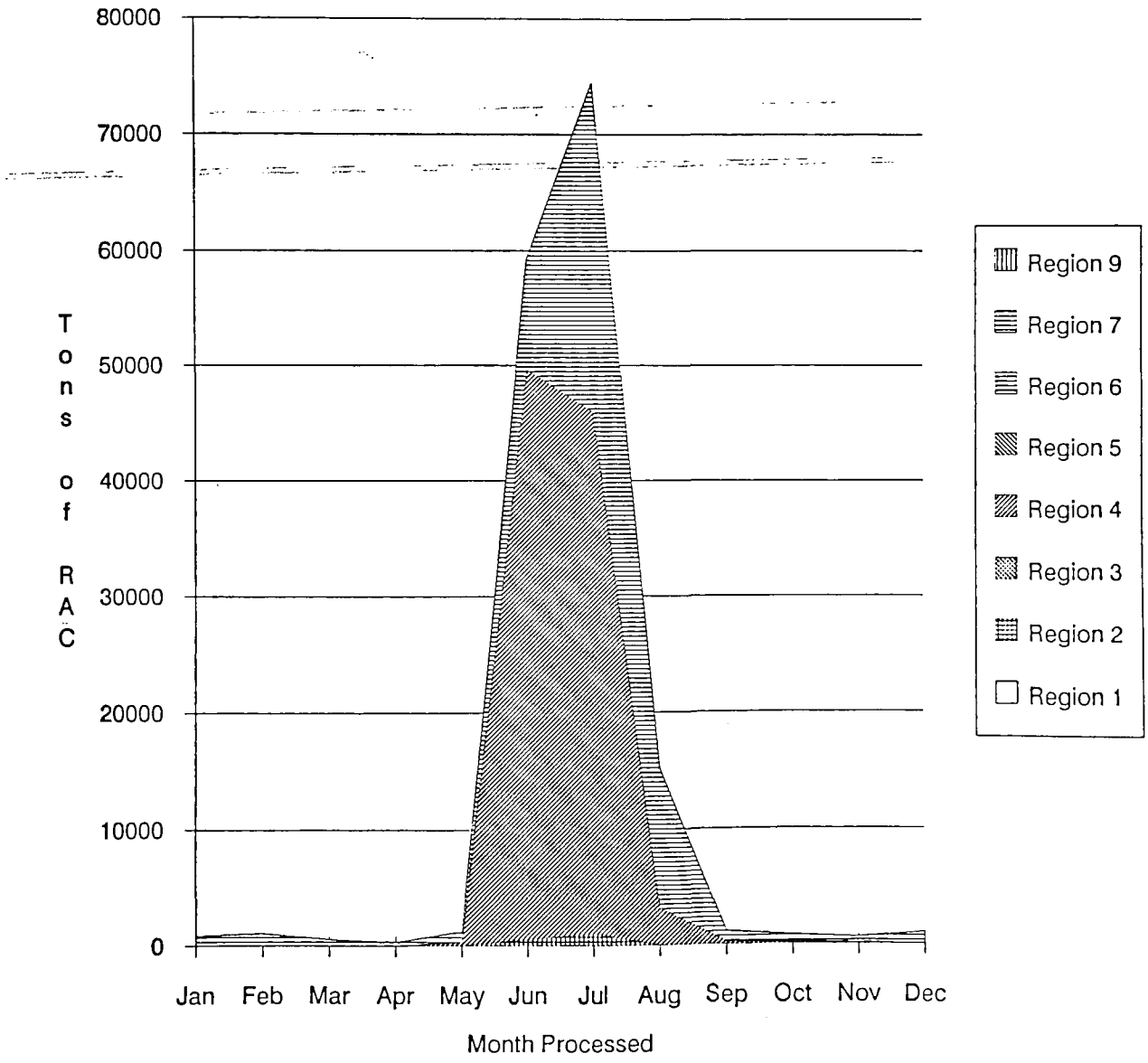


FIGURE A27. Processing Volume (tons/year) - Green peas

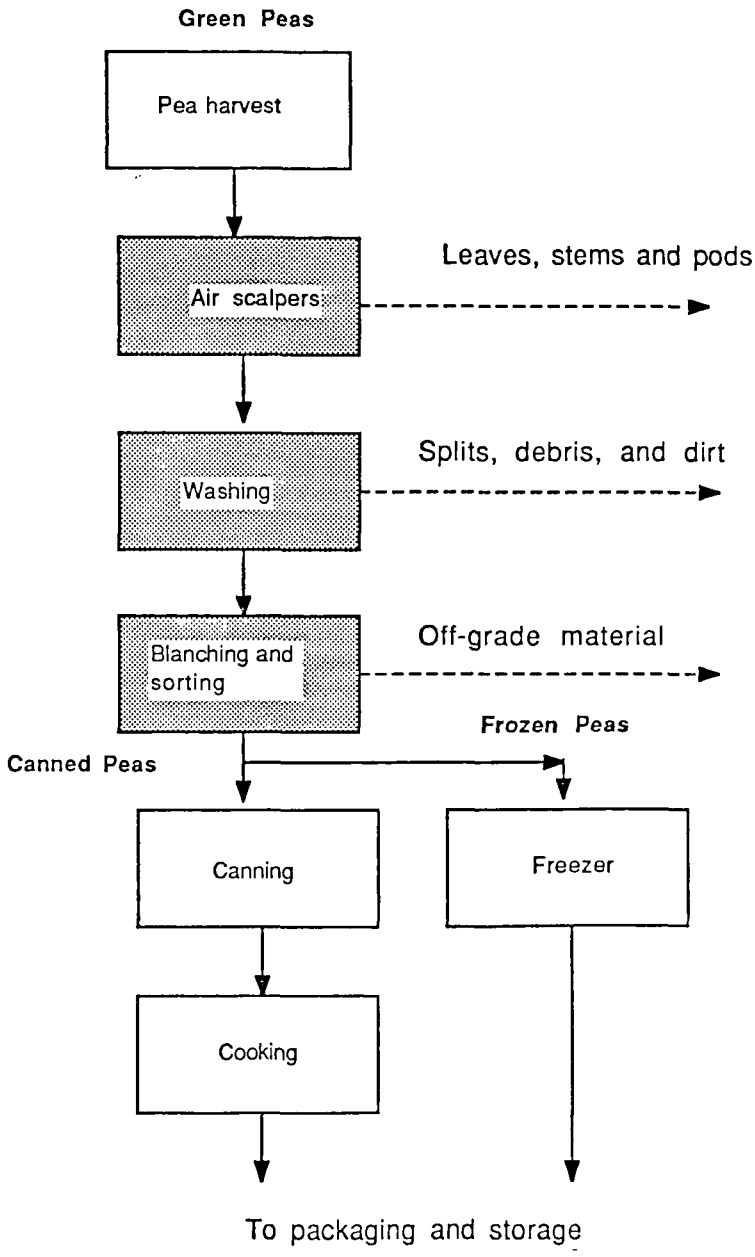


FIGURE A28. RAC Processing Flowsheet for Green Peas

COMMODITY: Spinach and other greens (includes collard and turnip greens).

PRODUCTS MADE: Canned or frozen greens.

ANIMALS FED: Cattle and hogs

PORTIONS FED: Reject leaves, small solids separated from blanching water.

TABLE A29. RAC Utilization Profile for Spinach and Other Greens

	Moisture Content (wt%)				RAC Utilization (see note a)			
Disposition	Min	Max	Mean	σ	Weight	Min	Max	Mean
RAC	90.0	91.0	90.3	0.5	21,898	174	16,680	3,650
Food Product	91.0	91.0	91.0	0.0	16,220	61%	100%	74%
Wet Feed	90.0	91.0	90.5	0.5	3,308	0%	39%	15%
Dry Feed	n.r	n.r.	n.r.	n.r.	875	0%	30%	4%
Land Applied	91.0	91.0	91.0	0.0	1,380	0%	8%	6%
Land Filled	n.r.	n.r.	n.r.	n.r.	115	0%	100%	1%
Burned	n.r.	n.r.	n.r.	n.r.	0	0%	0%	0%
Other	-				0	0%	0%	0%
Unaccounted for	-				0			0%

note (a): Values are in wt% of total RAC, except RAC and weight figures, which are in total tons/year.
n.r indicates that data was not reported by survey respondents.
() around data value indicates a negative mass balance error.

Processing Notes

Harvested greens are dry (air) cleaned to remove dirt, insects, then inspected to remove defective leaves and weeds. The inspected greens are then washed to remove any remaining dirt, and are blanched prior to chopping and filling. Wastes and byproducts (91 wt% m.c.) are derived from the inspection and filling steps.

TABLE A30. Reported Processing Volume (tons/year) for Greens

Total Vol (tons/yr)	Processing Volume in Survey Region (tons RAC/yr)							
	1	2	3	4	5	6	7	9
21,898	0	0	354	789	20,755	0	0	0

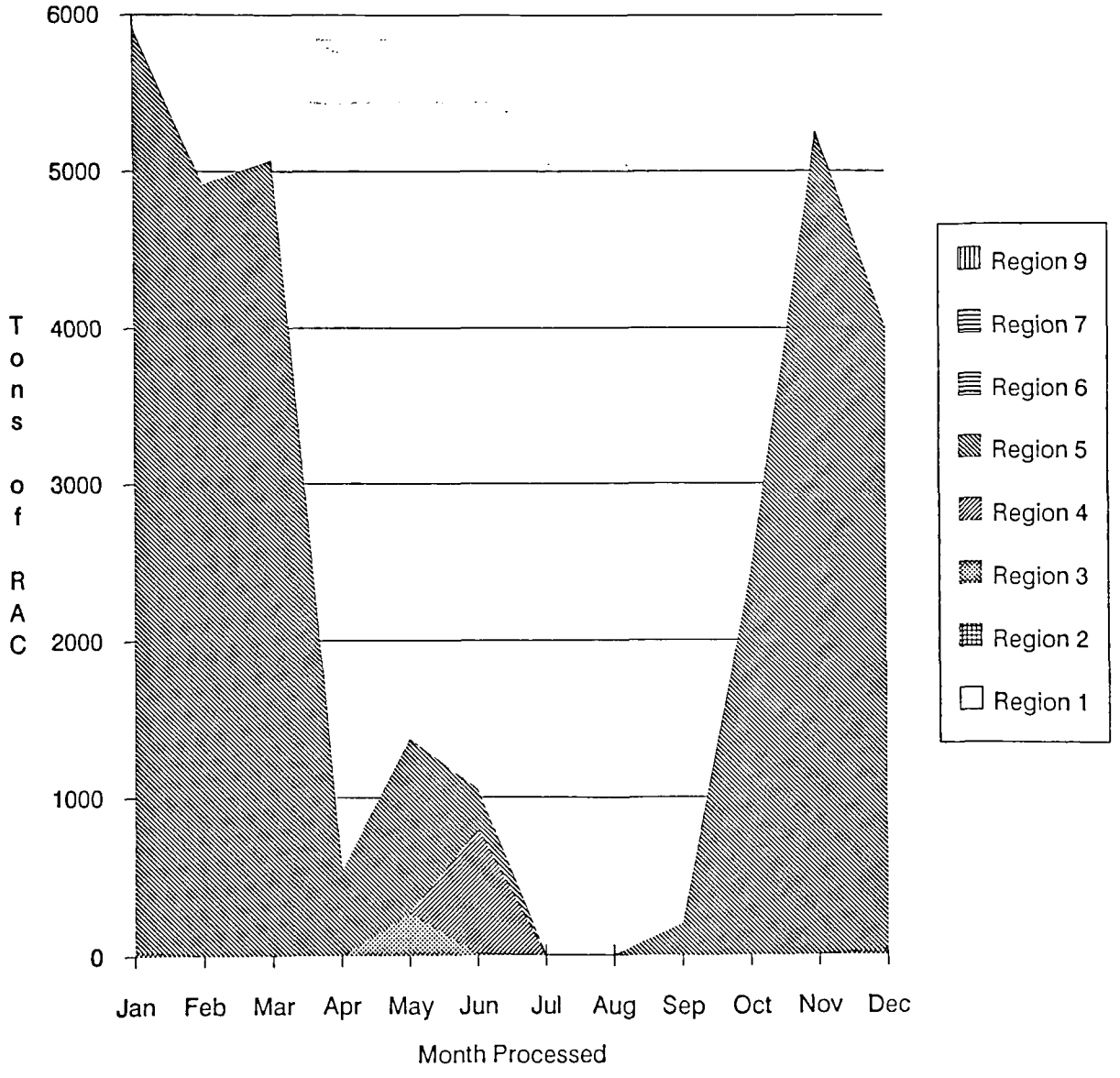


FIGURE A29. Processing Volume (tons/year) - Greens

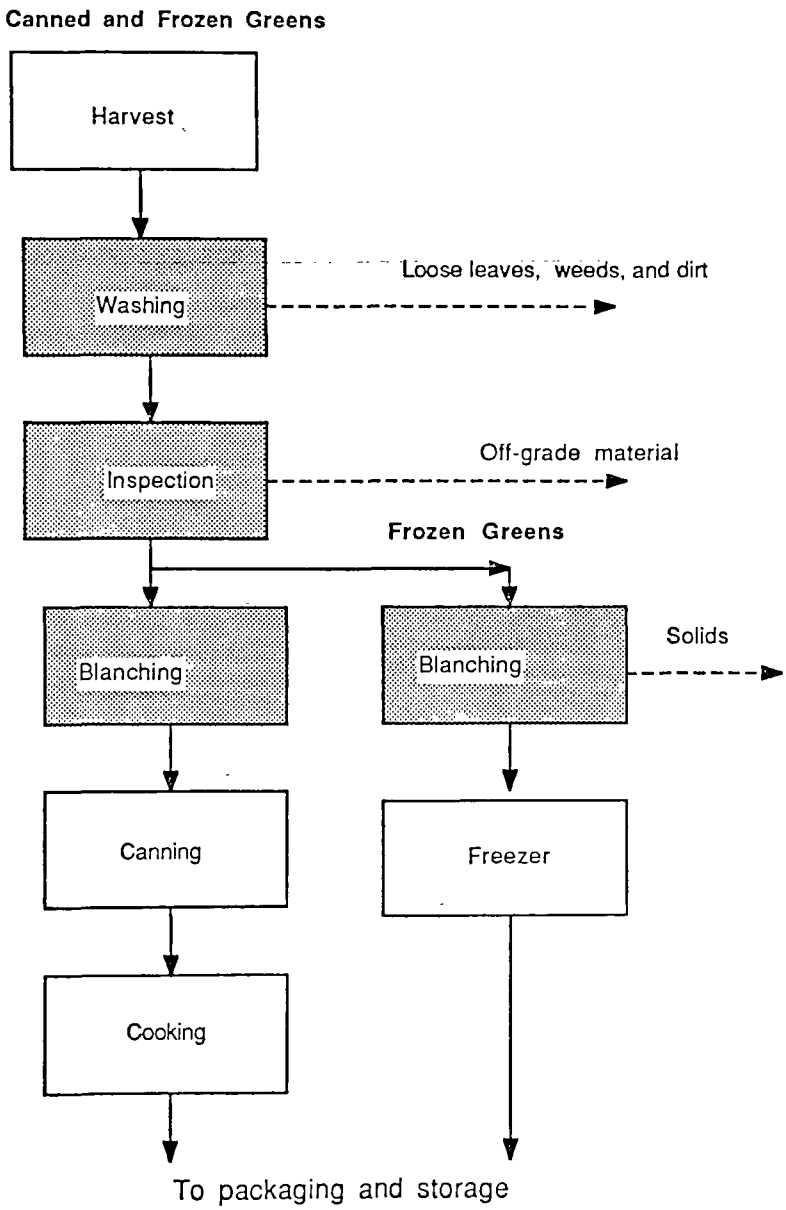


FIGURE A30. RAC Processing Flowsheet for Spinach and Other Greens

COMMODITY: Lima Beans

PRODUCTS MADE: Frozen and canned lima beans and vegetable blends

ANIMALS FED: Beef and dairy cattle, hogs

PORTIONS FED: Pods, weeds, culls and undersize pieces

TABLE A31. RAC Utilization Profile for Lima Beans

	Moisture Content (wt%)				RAC Utilization (see note a)			
Disposition	Min	Max	Mean	σ	Weight	Min	Max	Mean
RAC	12.0	85.0	67.1	23.7	9,270	141	3,927	1,030
Food Product	12.0	85.0	63.6	26.7	8,428	80%	95%	91%
Wet Feed	65.0	85.0	77.0	8.6	682	0%	20%	7%
Dry Feed	n.r.	n.r.	n.r.	n.r.	0	0%	0%	0%
Land Applied	12.0	85.0	48.5	36.5	130	0%	16%	1%
Land Filled	n.r.	n.r.	n.r.	n.r.	0	0%	100%	0%
Burned	n.r.	n.r.	n.r.	n.r.	0	0%	0%	0%
Other			-		30	0%	1%	0%
Unaccounted for	-		-		(0)			0%

note (a): Values are in wt% of total RAC, except RAC and weight figures, which are in total tons/year
n.r. indicates that data was not reported by survey respondents.
() around data value indicates a negative mass balance error.

Processing Notes

See entry for "Green Beans"

TABLE A32. Reported Processing Volume (tons/year) for Lima beans

Total Vol (tons/yr)	Processing Volume in Survey Region (tons RAC/yr)							
	1	2	3	4	5	6	7	9
9,270	Ø	141	Ø	4,308	Ø	Ø	4,821	Ø

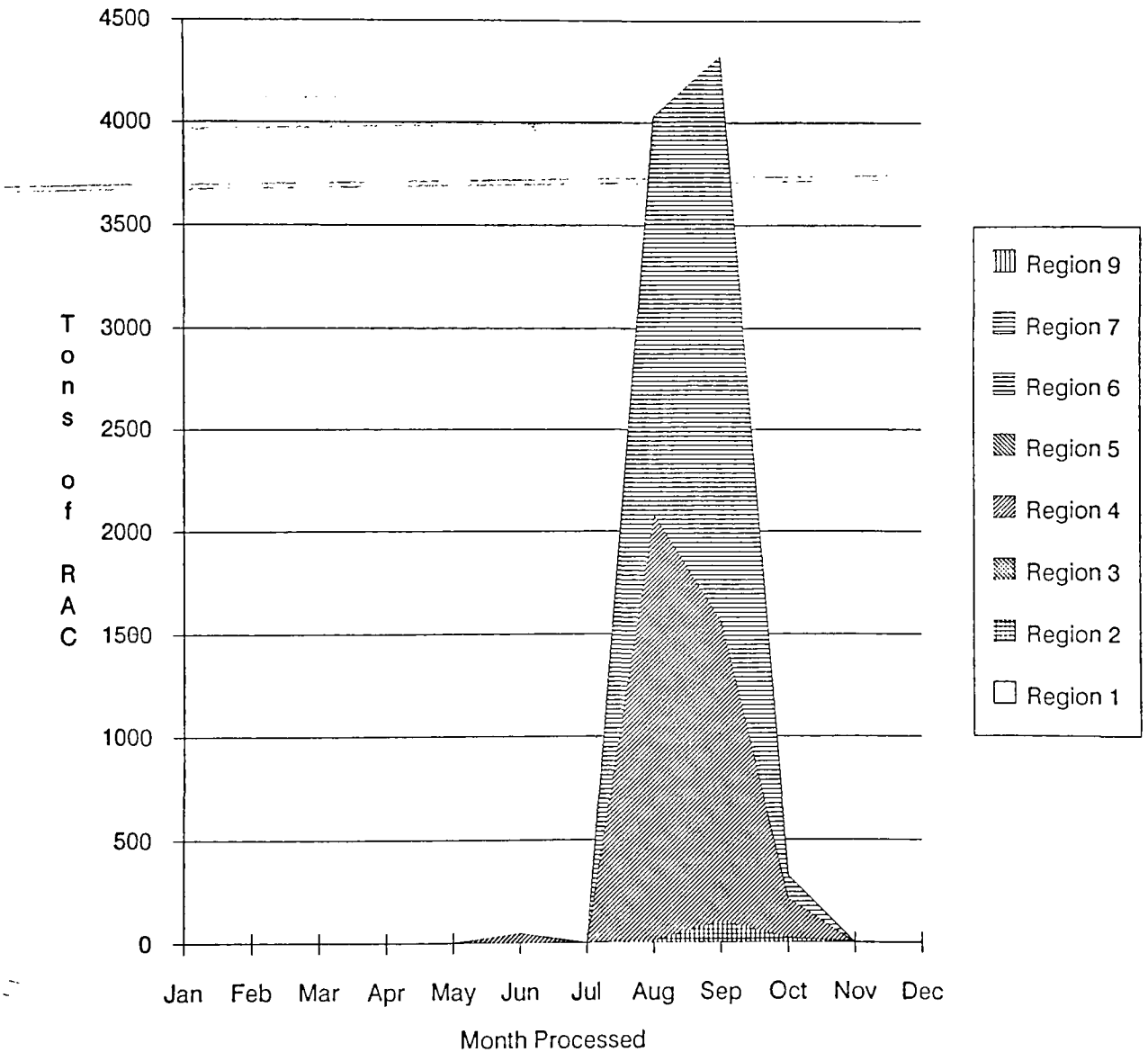


FIGURE A31. Processing Volume (tons/year) - Lima beans

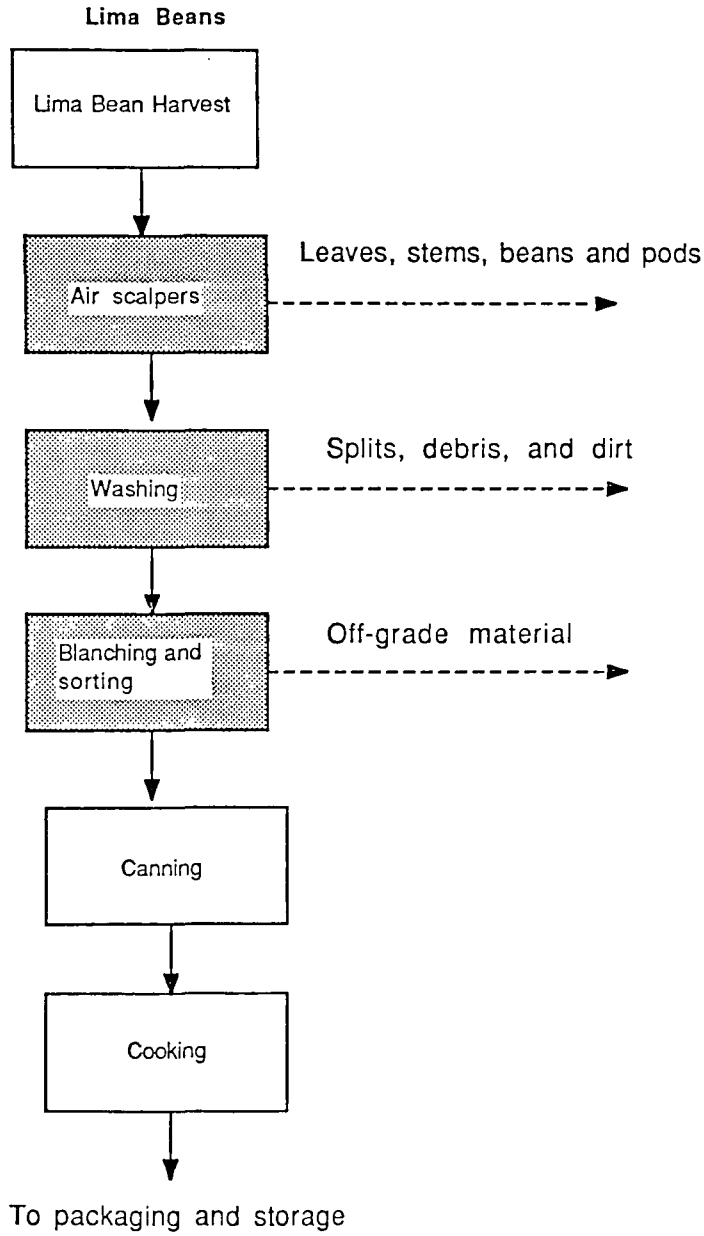


FIGURE A32. RAC Processing Flowsheet for Lima Beans

COMMODITY: Barley malt, hops and other cereal grains used to produce alcoholic beverages.

PRODUCTS MADE: Beer, distilled liquor, malt.

ANIMALS FED: Cattle, poultry, sheep.

PORTIONS FED: Dried (9 wt% m.c.) or wet (74 wt% m.c.) distiller's spent grain.

TABLE A33. RAC Utilization Profile for Malt Products

	Moisture Content (wt%)				RAC Utilization (see note a)			
Disposition	Min	Max	Mean	σ	Weight	Min	Max	Mean
RAC	4.0	13.0	9.7	2.9	1,241,481	259	237,984	62,074
Food Product	11.0	13.0	12.3	0.7	623,812	0%	88%	50%
Wet Feed	4.0	13.0	9.0	3.2	229,054	0%	100%	18%
Dry Feed	6.0	13.0	11.2	1.9	93,741	0%	37%	8%
Land Applied	n.r.	n.r.	n.r.	n.r.	0	0%	0%	0%
Land Filled	n.r.	n.r.	n.r.	n.r.	8,567	0%	100%	1%
Burned	n.r.	n.r.	n.r.	n.r.	0	0%	0%	0%
Other			-		254,230	0%	66%	20%
Unaccounted for					32,077			3%

note (a): Values are in wt% of total RAC, except RAC and weight figures, which are in total tons/year
n.r. indicates that data was not reported by survey respondents.
() around data value indicates a negative mass balance error.

Processing Notes

In the malting process, air-scalped barley is cleaned, graded, and then steeped to induce germination of the grains. The germinated grain is then dried to stop growth and enzyme activity. The dried malt is then used (either in-house or by second party) as the basis for brewing beer. The malt, along with other cereal grains and hops, are extracted to remove fermentable sugars and flavoring. The byproducts are the spent brewer's (or spent distiller's) grain, which may be used either wet or dry. Other byproducts are derived from the barley malt drying process, and from the grain cleaning operations.

Additional Comments

Although the malting of barley (usually for beer) is a distinct process from the production of cereal mash (usually for distilled spirits), most of the surveys tended to lump all of the ingredients together. Since most of the byproducts are very similar in character and end use, they are reported under a single heading.

TABLE A34. Reported Processing Volume (tons/year) for Malt

Total Vol (tons/yr)	Processing Volume in Survey Region (tons RAC/yr)							
	1	2	3	4	5	6	7	9
997,153	72,099	124,841	39,532	102,759	8,140	0	231,916	417,866

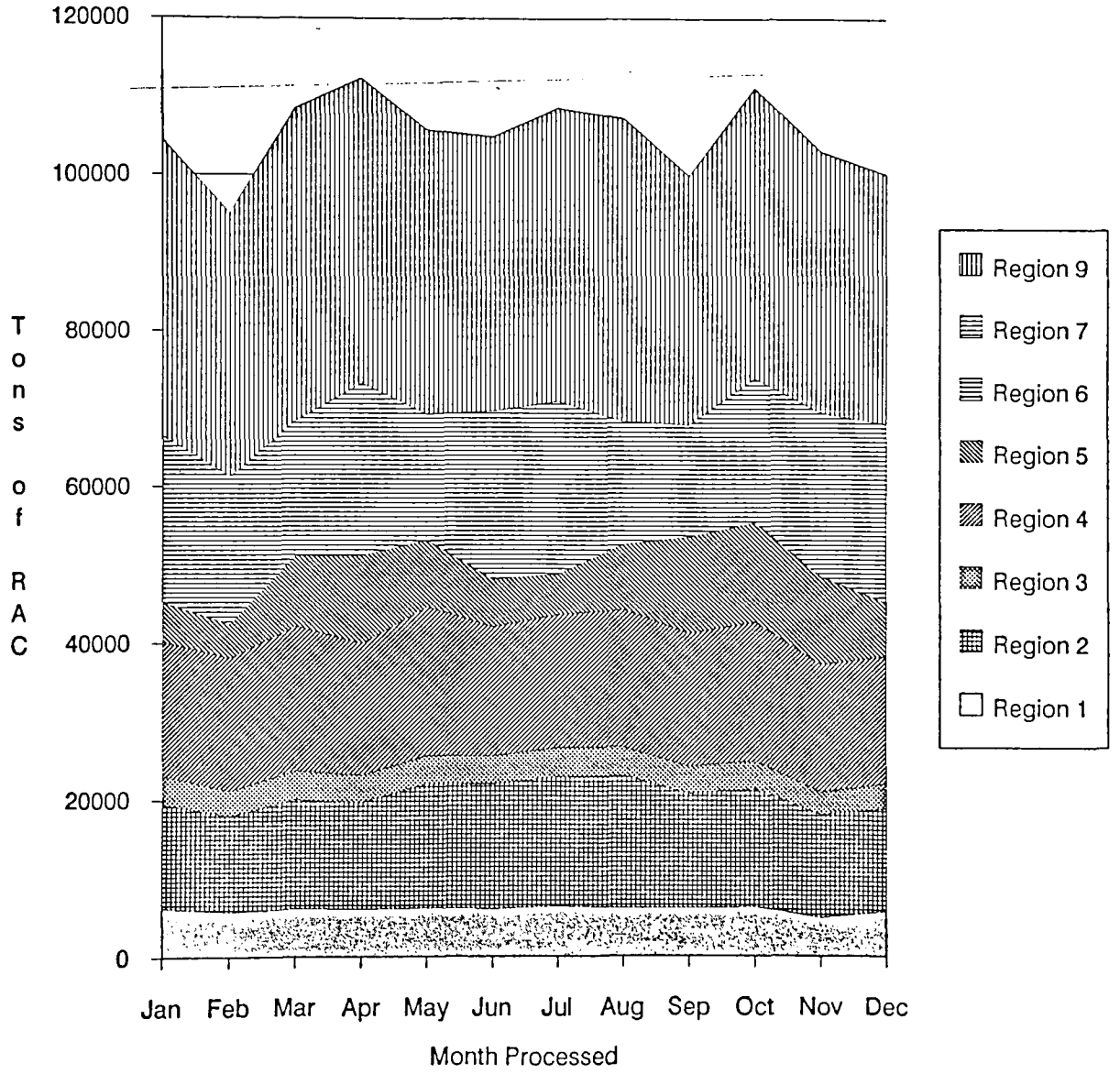


FIGURE A33. Processing Volume (tons/year) - Malt

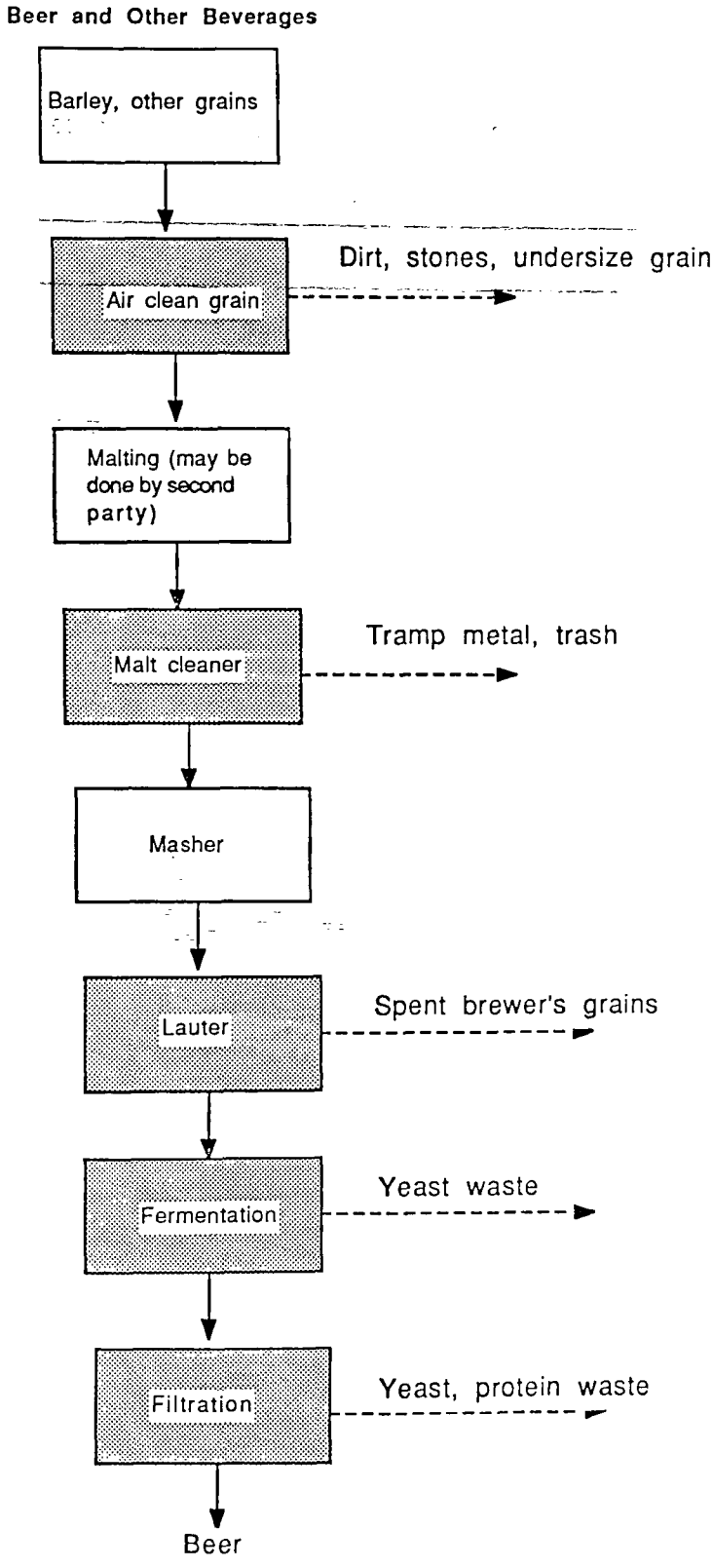


FIGURE A34. RAC Processing Flowsheet for Malt Products

COMMODITY: Miscellaneous Fruit. This category includes a variety of fruits including papaya, kiwi, and other tropical fruits which could not be reported individually because it would reveal potentially proprietary data. This category also includes respondents for which no individual RAC's were identified in the survey.

PRODUCTS MADE: The fruits reported here are processed to make fruit purees.

ANIMALS FED: Beef cattle

PORTIONS FED: Culls and pomace (80 wt% m.c.)

TABLE A35. RAC Utilization Profile for Miscellaneous Fruit

	Moisture Content (wt%)				RAC Utilization (see note a)			
Disposition	Min	Max	Mean	σ	Weight	Min	Max	Mean
RAC	71.9	92.0	84.7	6.1	193,623	745	180,000	24,203
Food Product	0.0	92.0	72.7	30.3	156,695	17%	85%	81%
Wet Feed	0.0	92.0	60.3	42.7	4,693	0%	74%	2%
Dry Feed	n.r.	n.r.	n.r.	n.r.	0	0%	0%	0%
Land Applied	n.r.	n.r.	n.r.	n.r.	0	0%	0%	0%
Land Filled	71.9	85.0	79.6	5.6	31,498	0%	100%	16%
Burned	n.r.	n.r.	n.r.	n.r.	0	0%	0%	0%
Other	-		-	-	636	0%	9%	0%
Unaccounted for				-	102			0%

note (a): Values are in wt% of total RAC, except RAC and weight figures, which are in total tons/year.
n.r. indicates that data was not reported by survey respondents.
() around data value indicates a negative mass balance error.

Processing Notes

No details provided.

TABLE A36. Reported Processing Volume (tons/year) for Misc fruit

Total Vol (tons/yr)	Processing Volume in Survey Region (tons RAC/yr)							
	1	2	3	4	5	6	7	9
193,623	Ø	Ø	Ø	Ø	Ø	Ø	Ø	193,623

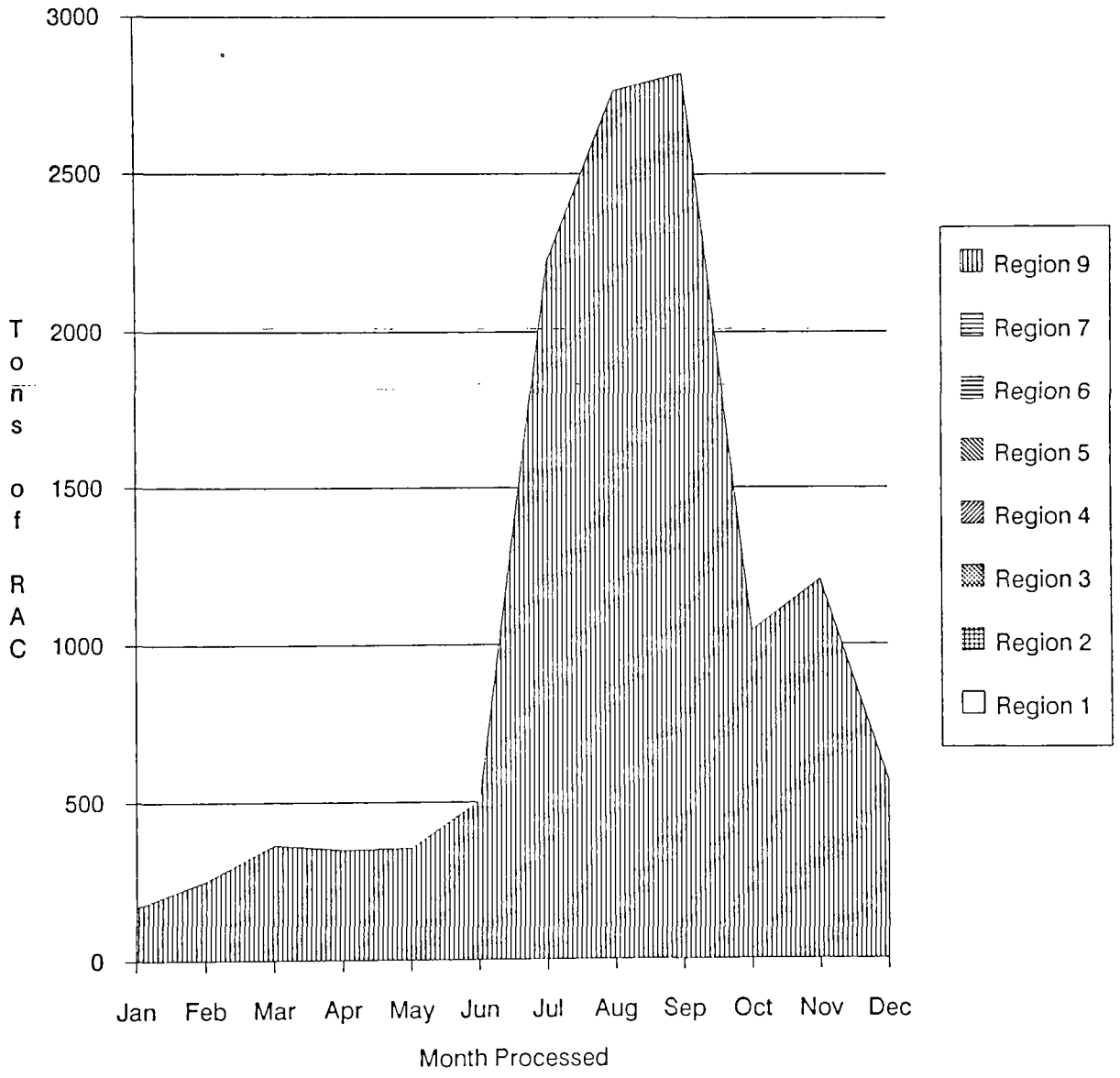


FIGURE A35. Processing Volume (tons/year) - Misc fruit

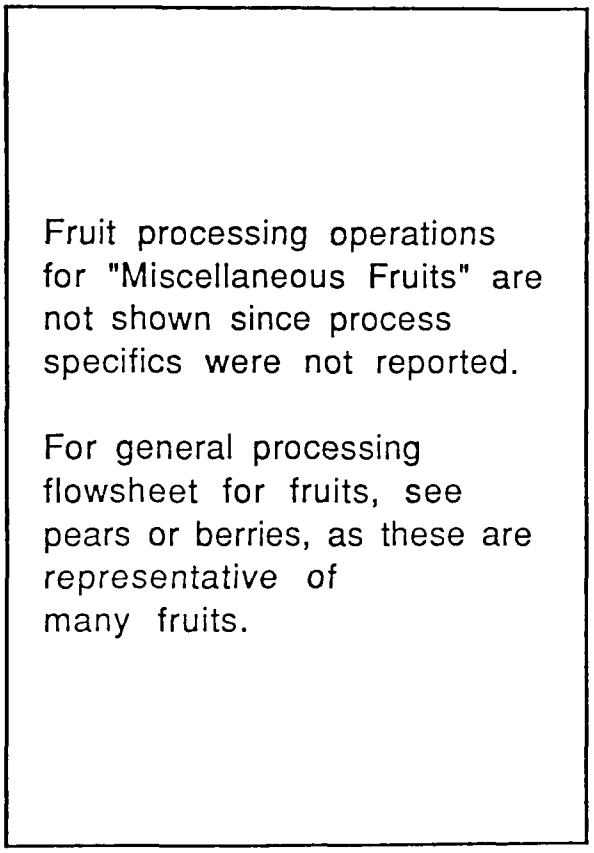


FIGURE A36. RAC Processing Flowsheet for Miscellaneous Fruit

COMMODITY: Miscellaneous vegetables (includes broccoli, cauliflower, okra, turnip roots and mixed corn/peas/beans)

PRODUCTS MADE: Canned and frozen vegetables

ANIMALS FED: Beef and dairy cattle, hogs, sheep

PORTIONS FED: broccoli butts and discolored florets, leaves, cauliflower cores and leaves, defective vegetables.

TABLE A37. RAC Utilization Profile for Miscellaneous Vegetables

	Moisture Content (wt%)				RAC Utilization (see note a)			
Disposition	Min	Max	Mean	σ	Weight	Min	Max	Mean
RAC	78.0	95.0	86.5	6.2	402,653	180	40,740	33,554
Food Product	78.0	95.0	84.6	5.7	198,057	23%	98%	49%
Wet Feed	80.0	90.0	83.8	3.7	176,419	0%	74%	44%
Dry Feed	n.r.	n.r.	n.r.	n.r.	0	0%	0%	0%
Land Applied	0.0	85.0	42.5	42.5	22,035	0%	6%	5%
Land Filled	78.0	78.0	78.0	0.0	135	0%	100%	0%
Burned	n.r.	n.r.	n.r.	n.r.	0	0%	0%	0%
Other					5,837	0%	9%	1%
Unaccounted for					170			0%

note (a): Values are in wt% of total RAC, except RAC and weight figures, which are in total tons/year.
n.r. indicates that data was not reported by survey respondents.
() around data value indicates a negative mass balance error.

Processing Notes

This category includes vegetables processed for canned and frozen products, but which were not represented in sufficient quantities to treat as individual commodities. This category also includes responses which reported their data without distinguishing between RACs. An approximate breakdown of RACs included in this category is: mixed corn/beans/peas/beets, 375,000 tpy; cauliflower, 24,000 tpy; okra, 1,300 tpy; broccoli, 1,100 tpy; rhubarb, 1,000 tpy; turnip roots, 670 tpy; and tomatillos, 380 tpy.

TABLE A38. Reported Processing Volume (tons/year) for Misc vegetables

Total Vol (tons/yr)	Processing Volume in Survey Region (tons RAC/yr)							
	1	2	3	4	5	6	7	9
402,653	0	0	0	49,210	1,981	0	351,081	382

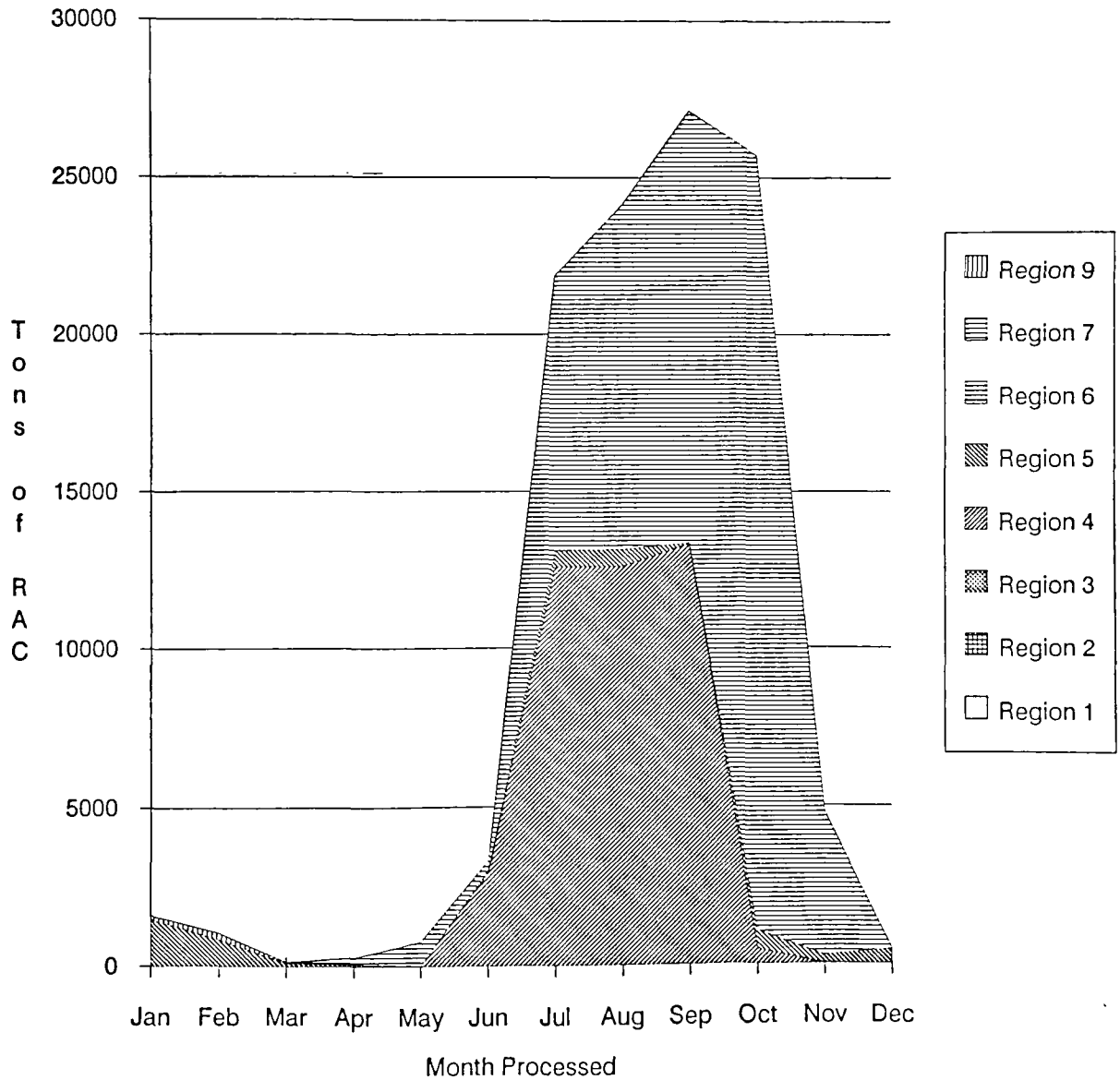


FIGURE A37. Processing Volume (tons/year) - Misc vegetables

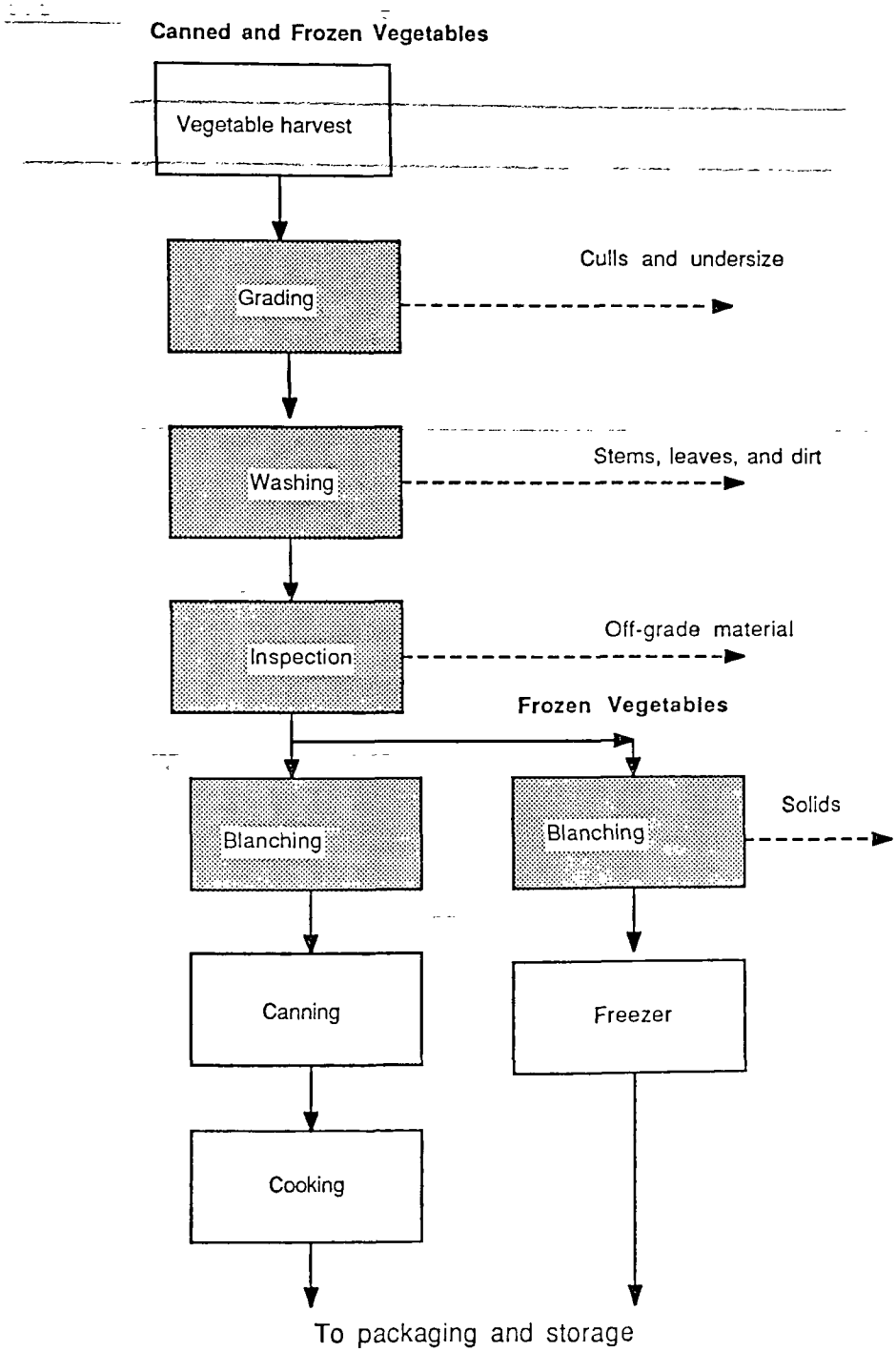


FIGURE A38. RAC Processing Flowsheet for Miscellaneous Vegetables

COMMODITY: Mushrooms

PRODUCTS MADE: Canned & IQF mushrooms

ANIMALS FED: None.

PORTIONS FED: NA

TABLE A39. RAC Utilization Profile for Mushrooms

	Moisture Content (wt%)				RAC Utilization (see note a)			
Disposition	Min	Max	Mean	σ	Weight	Min	Max	Mean
RAC	85.0	93.0	90.8	3.3	7,451	201	4,344	1,863
Food Product	85.0	93.0	90.3	3.8	5,246	60%	99%	70%
Wet Feed	n.r.	n.r.	n.r.	n.r.	0	0%	0%	0%
Dry Feed	n.r.	n.r	n.r.	n.r.	0	0%	0%	0%
Land Applied	n.r.	n.r	n.r.	n.r.	0	0%	0%	0%
Land Filled	n.r.	n.r	n.r.	n.r.	107	0%	100%	1%
Burned	n.r.	n.r	n.r.	n.r.	0	0%	0%	0%
Other			-		2,098	0%	38%	28%
Unaccounted for			-		(0)			0%

note (a): Values are in wt% of total RAC, except RAC and weight figures, which are in total tons/year.
n.r. indicates that data was not reported by survey respondents.
() around data value indicates a negative mass balance error.

Processing Notes

Mushroom processing operations consist of the familiar sequence of washing, sorting, (slicing) and packaging. Both canned and IQF mushrooms are represented in the survey. Wastes consist of small pieces screened from the wash water, dirt, defective mushrooms and reject batches. No waste moisture content data was available from the survey responses, but this type of waste material would be expected to have similar moisture levels as the raw commodity (91 wt% m.c.). All reported wastes were landfilled.

TABLE A40. Reported Processing Volume (tons/year) for Mushrooms

Total Vol (tons/yr)	Processing Volume in Survey Region (tons RAC/yr)							
	1	2	3	4	5	6	7	9
7,451	Ø	7,250	Ø	Ø	Ø	Ø	Ø	201

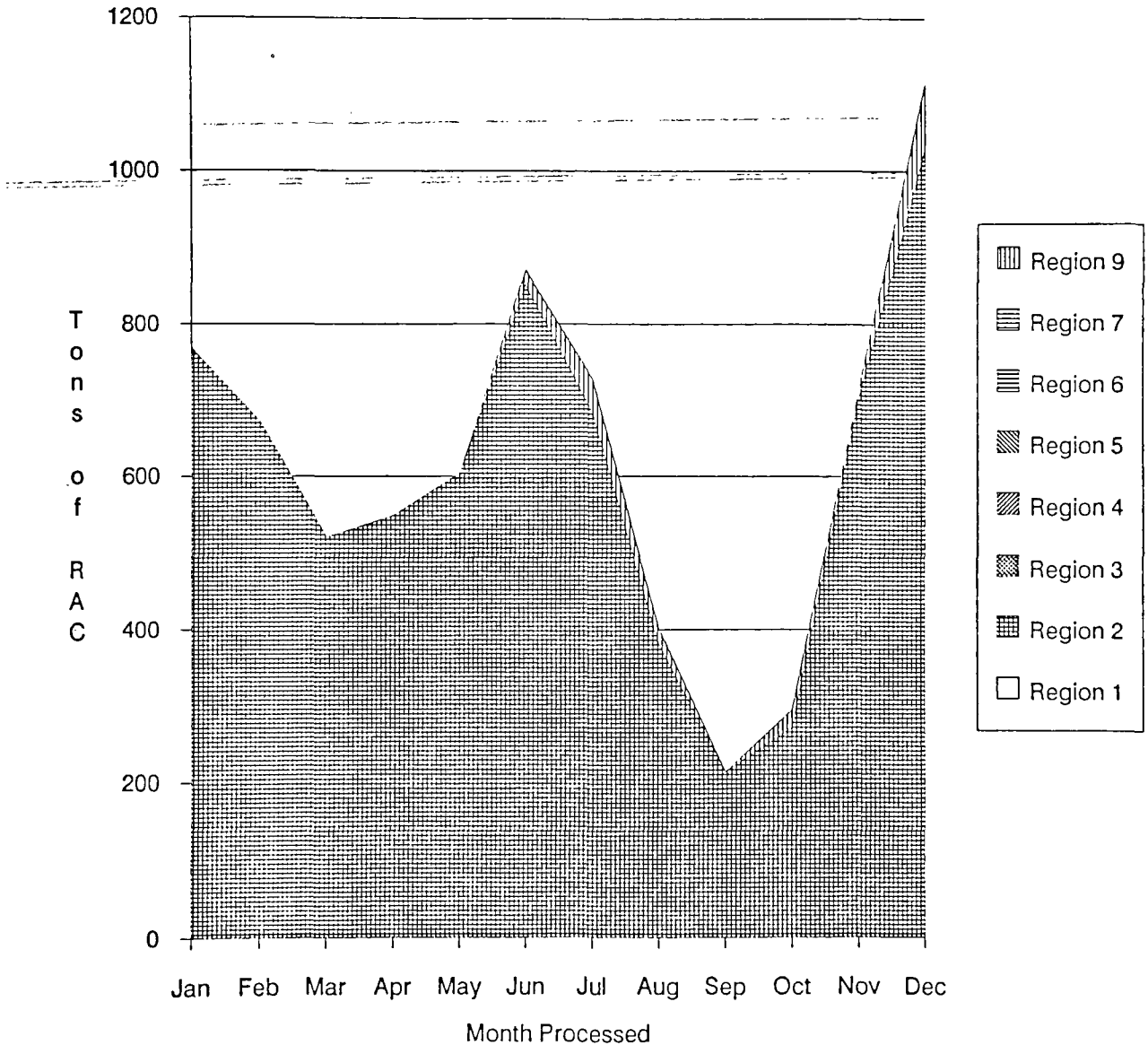


FIGURE A39. Processing Volume (tons/year) - Mushrooms

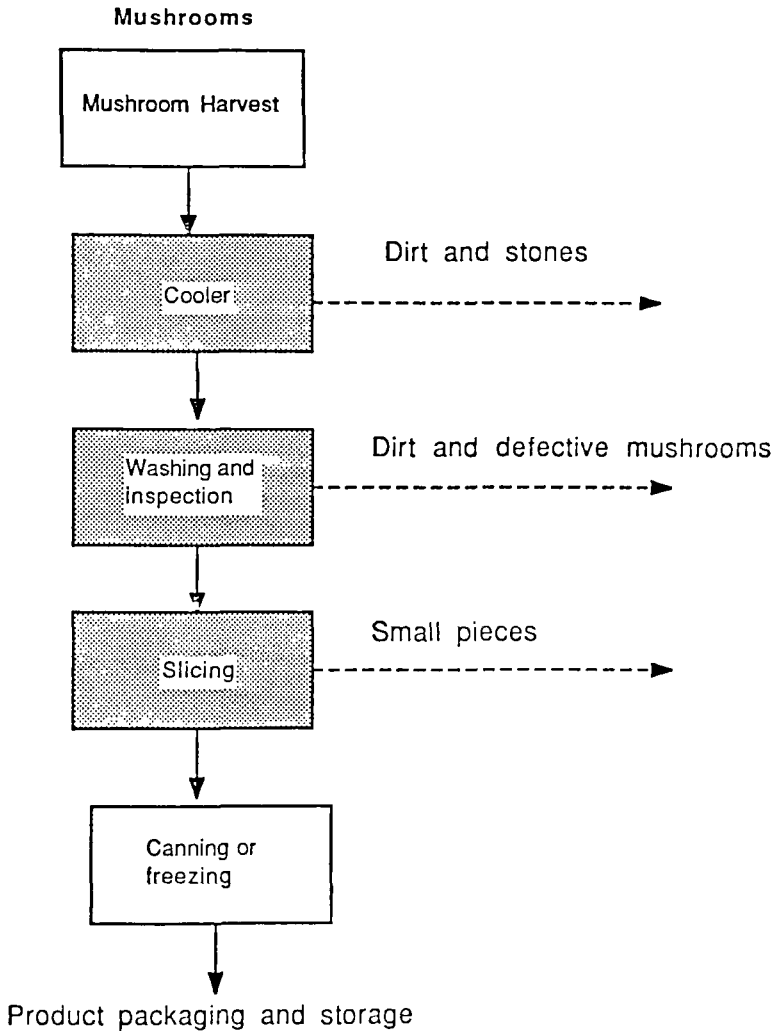


FIGURE A40. RAC Processing Flowsheet for Mushrooms

COMMODITY: Olives

PRODUCTS MADE: Brined canned olives

ANIMALS FED: None reported.

PORTIONS FED: NA

TABLE A41. RAC Utilization Profile for Olives

	Moisture Content (wt%)				RAC Utilization (see note a)			
Disposition	Min	Max	Mean	σ	Weight	Min	Max	Mean
RAC	n.r.	n.r.	83.0	n.r.	18,338	n.r.	n.r.	18,338
Food Product	n.r.	n.r.	83.0	n.r.	13,020	n.r.	n.r.	71%
Wet Feed	n.r.	n.r.	n.r.	n.r.	0	0%	0%	0%
Dry Feed	n.r.	n.r.	n.r.	n.r.	0	0%	0%	0%
Land Applied	n.r.	n.r.	n.r.	n.r.	0	0%	0%	0%
Land Filled	n.r.	n.r.	n.r.	n.r.	367	n.r.	n.r.	2%
Burned	n.r.	n.r.	n.r.	n.r.	4,951	n.r.	n.r.	27%
Other					0	0%	0%	0%
Unaccounted for	-				0			0%

note (a): Values are in wt% of total RAC, except RAC and weight figures, which are in total tons/year.
n.r. indicates that data was not reported by survey respondents.
() around data value indicates a negative mass balance error.

Processing Notes

Slightly under-ripe olives are sized and sorted to eliminate culls and undersize olives. Sorted olives are stored in brine for processing to extend the processing season. Stored olives are pitted and inspected, and may be canned either whole or sliced. Byproducts consist of pits, culls, and undersize olives, along with leaves that may have been shipped with the raw olives. The leaves and some of the undersized olives are landfilled, and the remainder of the wastes (51 wt% m.c.) are burned for process heat.

Additional Comments

Survey statistical data was omitted to protect against disclosure of confidential business information.

TABLE A42. Reported Processing Volume (tons/year) for Olives

Total Vol (tons/yr)	Processing Volume in Survey Region (tons RAC/yr)							
	1	2	3	4	5	6	7	9
18,338	Ø	Ø	Ø	Ø	Ø	Ø	Ø	18,338

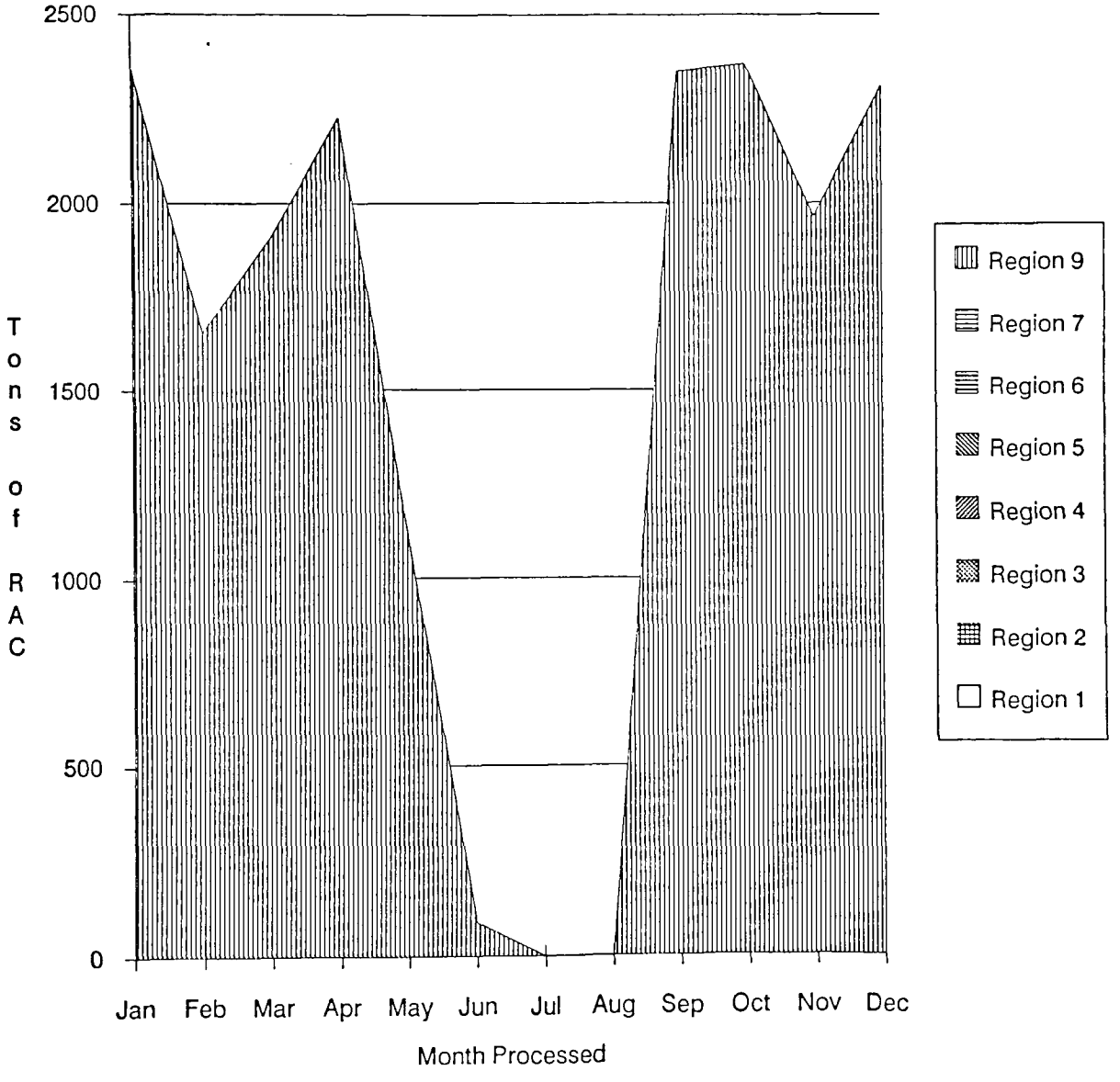


FIGURE A41. Processing Volume (tons/year) - Olives

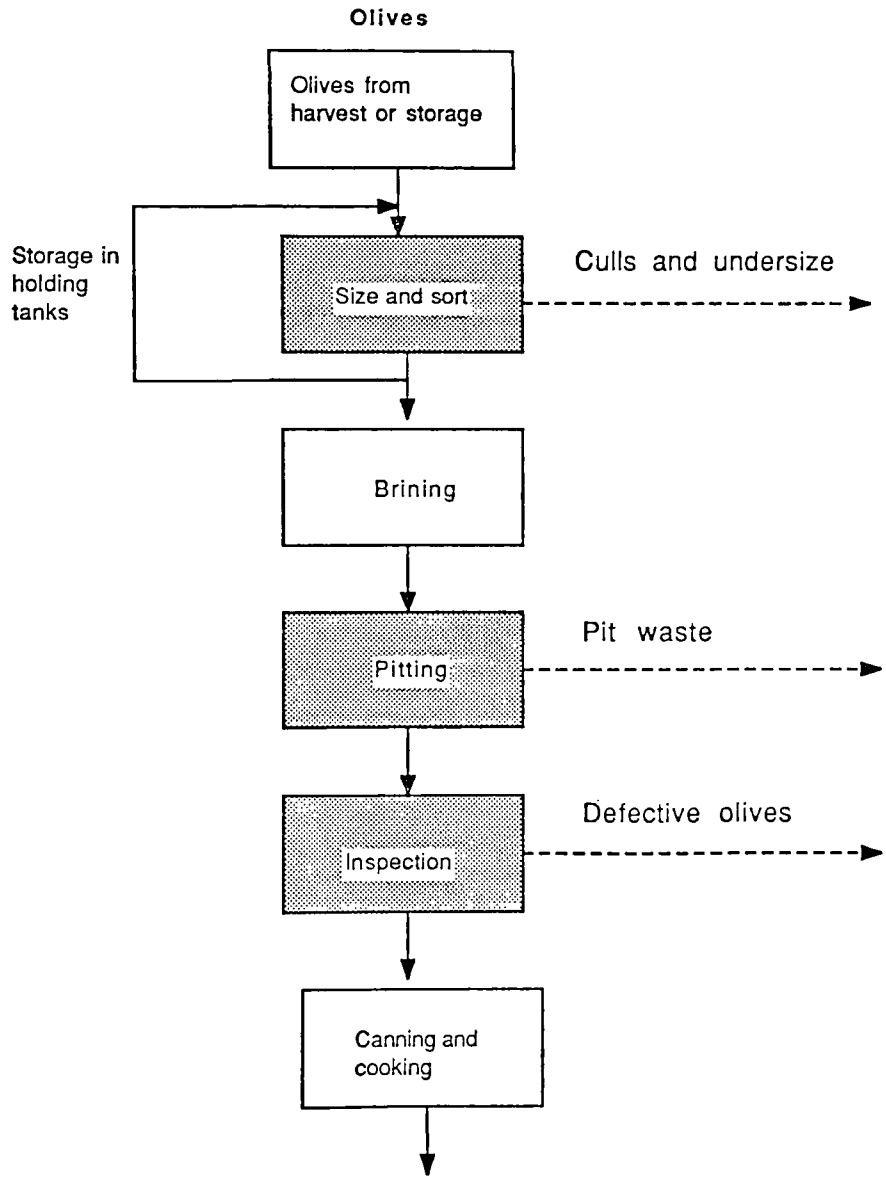


FIGURE A42. RAC Processing Flowsheet for Olives

COMMODITY: Onions

PRODUCTS MADE: Onion rings; specialty sauces; IQF baby onions; pickled/brined onions.

ANIMALS FED: Cattle and hogs.

PORTIONS FED: Skins, roots, tops, weeds and culls.

TABLE A43. RAC Utilization Profile for Onions

	Moisture Content (wt%)				RAC Utilization (see note a)			
Disposition	Min	Max	Mean	σ	Weight	Min	Max	Mean
RAC	87.5	92.0	89.2	2.0	10,109	1,055	5,067	2,527
Food Product	88.0	92.0	90.0	2.0	6,423	49%	96%	64%
Wet Feed	88.0	88.0	88.0	0.0	2,058	0%	46%	20%
Dry Feed	n.r.	n.r.	n.r	n.r.	540	0%	30%	5%
Land Applied	88.0	88.0	88.0	0.0	109	0%	5%	1%
Land Filled	92.0	92.0	92.0	0.0	42	0%	100%	0%
Burned	n.r.	n.r.	n.r.	n.r.	0	0%	0%	0%
Other		-			937	0%	18%	9%
Unaccounted for			-		0			0%

note (a): Values are in wt% of total RAC, except RAC and weight figures, which are in total tons/year.
n.r. indicates that data was not reported by survey respondents.
() around data value indicates a negative mass balance error.

Processing Notes

Onions for canning are stripped of their outer skin, blanched and canned.

Additional Comments

Relatively little information was provided by onion processors responding to the survey.

TABLE A44. Reported Processing Volume (tons/year) for Onions

Total Vol (tons/yr)	Processing Volume in Survey Region (tons RAC/yr)							
	1	2	3	4	5	6	7	9
10,109	0	0	0	2,187	1,800	0	5,067	1,055

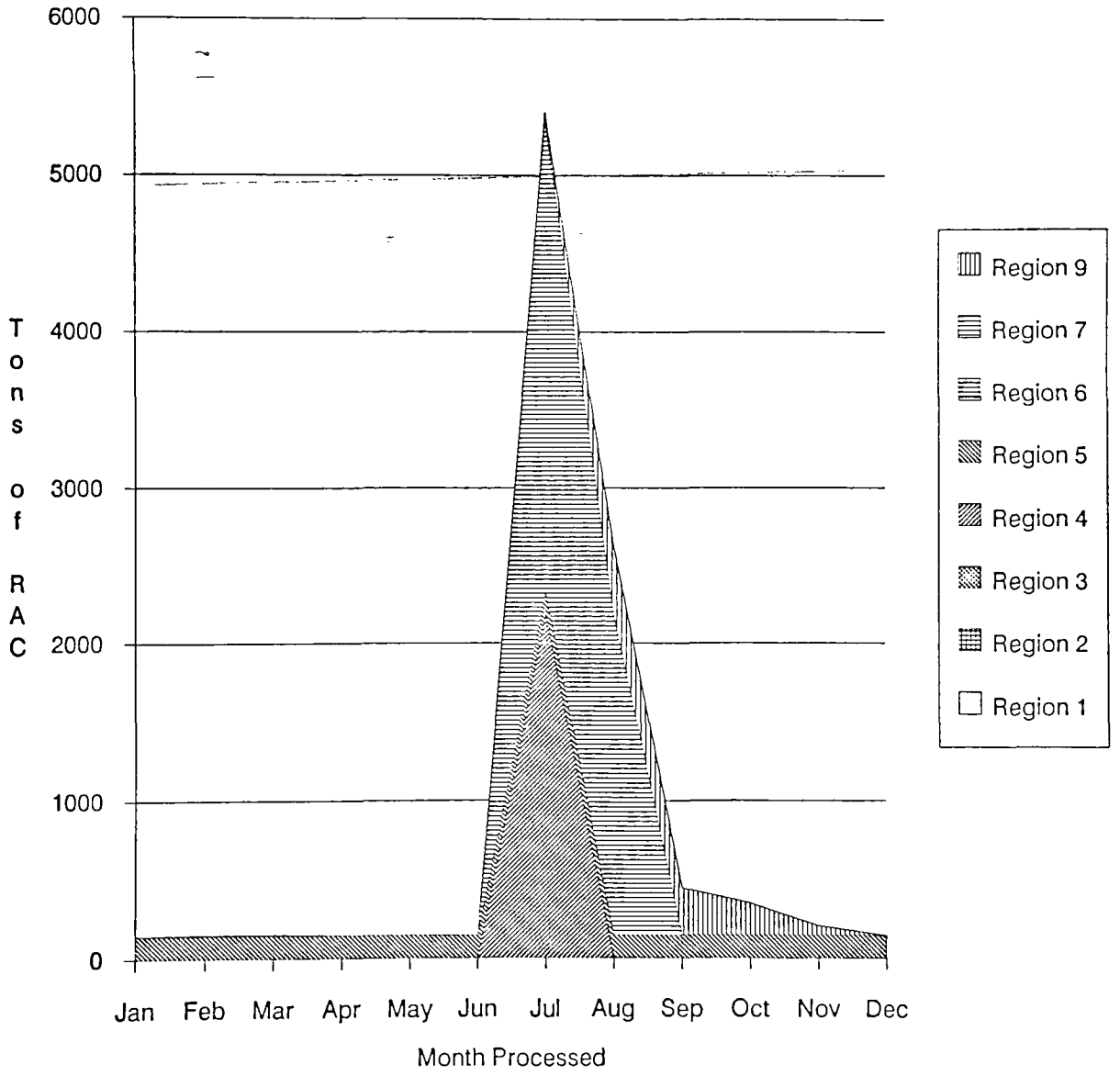


FIGURE A43. Processing Volume (tons/year) - Onions

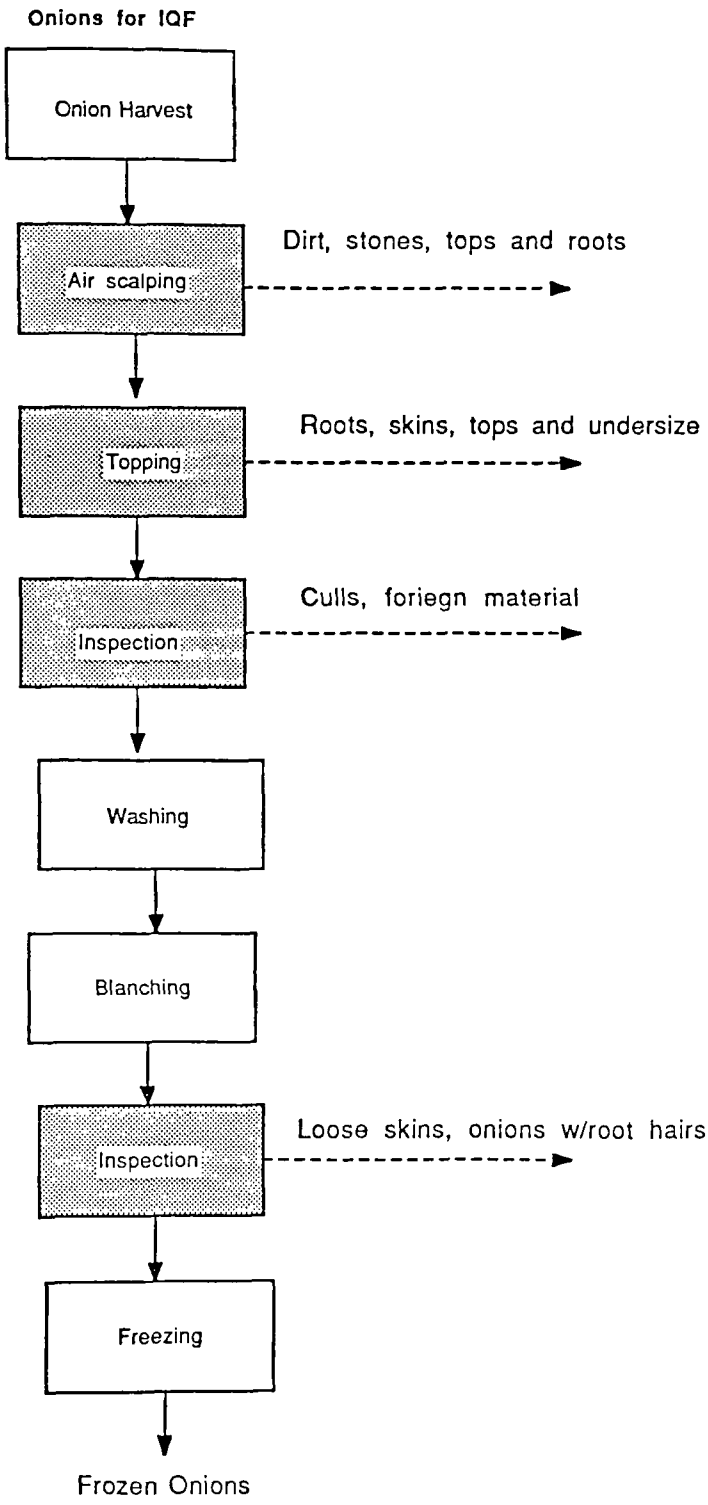


FIGURE A44. RAC Processing Flowsheet for Onions

COMMODITY: Peaches (includes apricots and nectarines)

PRODUCTS MADE: Canned halved/sliced/diced peaches and fruit cocktail; wine.

ANIMALS FED: Beef cattle.

PORTIONS FED: Culls, leaves, "wet waste" (settled solids, etc).

TABLE A45. RAC Utilization Profile for Peaches

	Moisture Content (wt%)				RAC Utilization (see note a)			
Disposition	Min	Max	Mean	σ	Weight	Min	Max	Mean
RAC	85.0	91.0	88.0	1.9	532,510	3	86,696	23,153
Food Product	85.0	89.0	86.9	1.5	422,311	59%	92%	79%
Wet Feed	85.0	90.0	87.6	2.2	15,903	0%	27%	3%
Dry Feed	n.r.	n.r.	n.r.	n.r.	0	0%	0%	0%
Land Applied	87.0	91.0	89.3	1.7	40,880	0%	26%	8%
Land Filled	87.0	87.0	87.0	0.0	23,784	0%	100%	4%
Burned	90.0	90.0	90.0	0.0	20,059	0%	7%	4%
Other					10,813	0%	16%	2%
Unaccounted for					(1,240)			0%

note (a): Values are in wt% of total RAC, except RAC and weight figures, which are in total tons/year.
n.r. indicates that data was not reported by survey respondents.
() around data value indicates a negative mass balance error.

Processing Notes

Harvested peaches are generally hydrocooled (immersed in water to reduce their temperature quickly) and may be stored in cold storage prior to processing. Attached leaves are removed and the fruit is inspected and graded to eliminate decay and split fruit prior to pitting. Several processing plants reported either using the pits (38 wt% mean m.c.) as fuel or selling them as a fuel to a second party. The halved, pitted fruit is peeled (steam or caustic peeling methods are both used). The peel waste is often discharged to the gutter for treatment (ie., pH neutralization of the caustic used for peeling) and is recovered on the wastewater screen along with other solids from the process. Peel waste was not reported as a component of the livestock feed, but rather was either land applied or landfilled. The mean m.c. of the aggregate non-feed waste was 80-87 wt%.

TABLE A46. Reported Processing Volume (tons/year) for Peaches

Total Vol (tons/yr)	Processing Volume in Survey Region (tons RAC/yr)							
	1	2	3	4	5	6	7	9
532,510	3	0	0	5,032	5,120	0	800	521,555

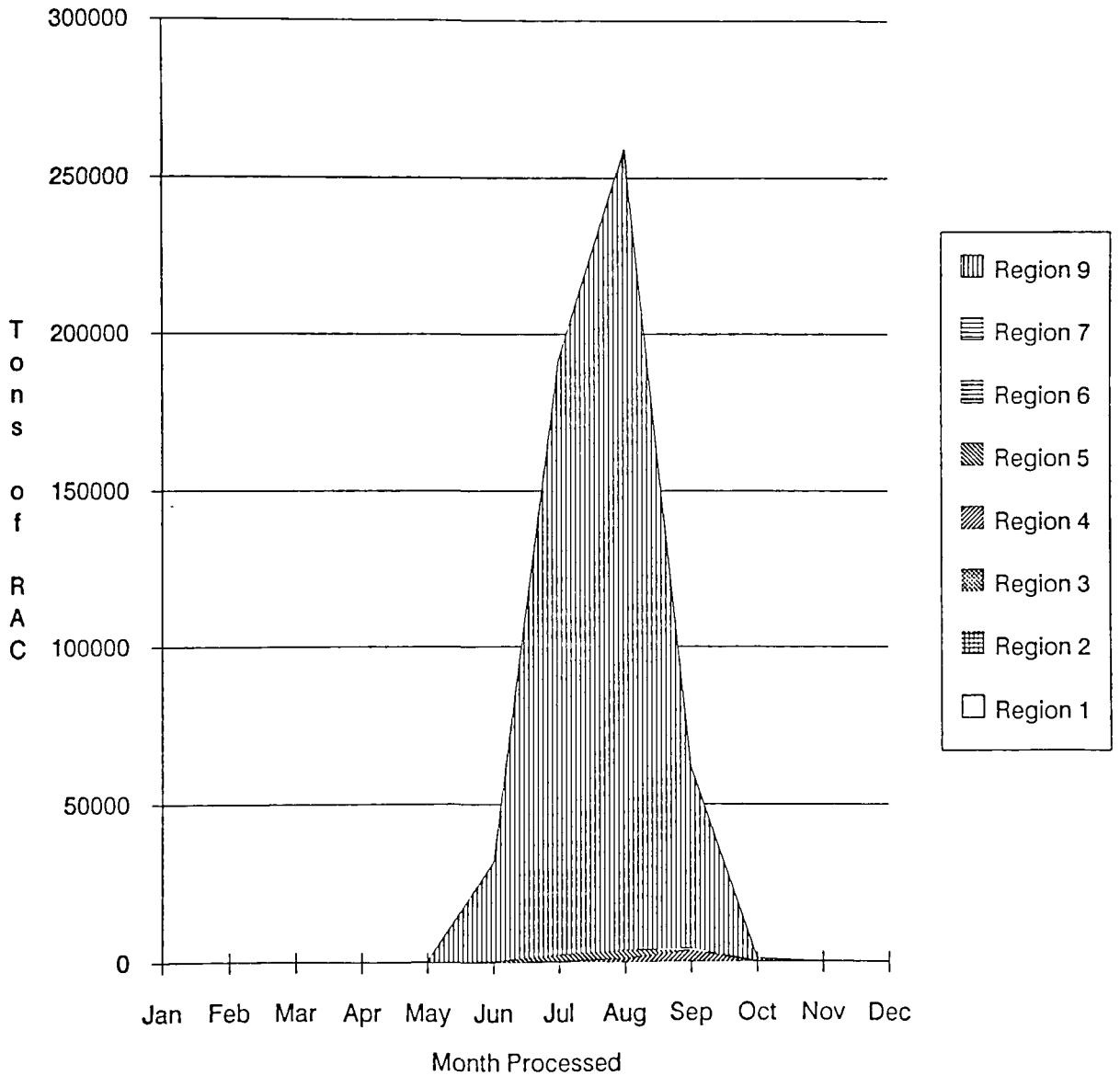


FIGURE A45. Processing Volume (tons/year) - Peaches

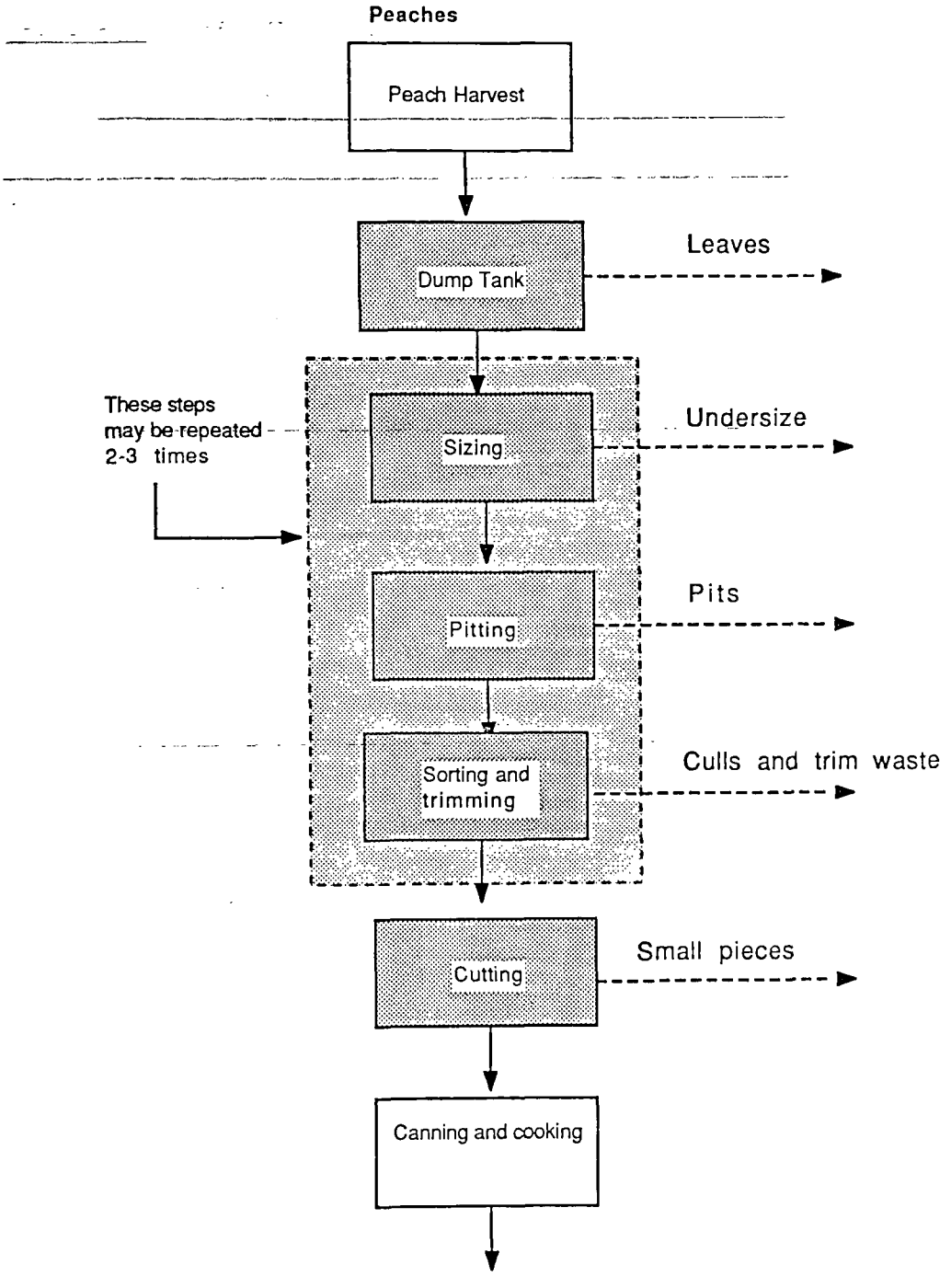


FIGURE A46. RAC Processing Flowsheet for Peaches

COMMODITY: Peanuts

PRODUCTS MADE: Peanut butter, peanut oil, shelled peanuts

ANIMALS FED: Cattle, hogs, poultry

PORTIONS FED: Meal (from oil processes) and hulls; skins, hearts.

TABLE A47. RAC Utilization Profile for Peanuts

	Moisture Content (wt%)				RAC Utilization (see note a)			
Disposition	Min	Max	Mean	σ	Weight	Min	Max	Mean
RAC	6.7	10.0	7.7	1.2	108,803	1,750	45,394	18,134
Food Product	6.7	10.0	7.9	1.3	91,046	33%	96%	84%
Wet Feed	n.r.	n.r.	n.r	n.r.	0	0%	0%	0%
Dry Feed	6.8	6.8	6.8	n.r.	7,376	0%	60%	7%
Land Applied	8.0	8.0	8.0	0.0	1,879	0%	10%	2%
Land Filled	n.r.	n.r.	n.r.	n.r.	723	0%	100%	1%
Burned	n.r.	n.r.	n.r	n.r.	7,405	0%	22%	7%
Other	-				543	0%	5%	0%
Unaccounted for				-	(168)			0%

note (a): Values are in wt% of total RAC, except RAC and weight figures, which are in total tons/year.
n.r. indicates that data was not reported by survey respondents.
() around data value indicates a negative mass balance error.

Processing Notes

Peanuts processed for peanut oil are air cleaned, hulled and cooked prior to pressing and solvent extraction. The primary byproducts are the hulls and the desolventized peanut meal, which can be used for cattle feed. The hulls may also be used for non-feed uses (ie, horse bedding was one reported use) or burned. Peanuts for other products do not generate a meal fraction. The skin waste, which is a byproduct from non-oil processing, is alternately landfilled or fed to cattle.

TABLE A48. Reported Processing Volume (tons/year) for Peanuts

Total Vol (tons/yr)	Processing Volume in Survey Region (tons RAC/yr)							
	1	2	3	4	5	6	7	9
108,803	0	0	35,410	5,249	68,144	0	0	0

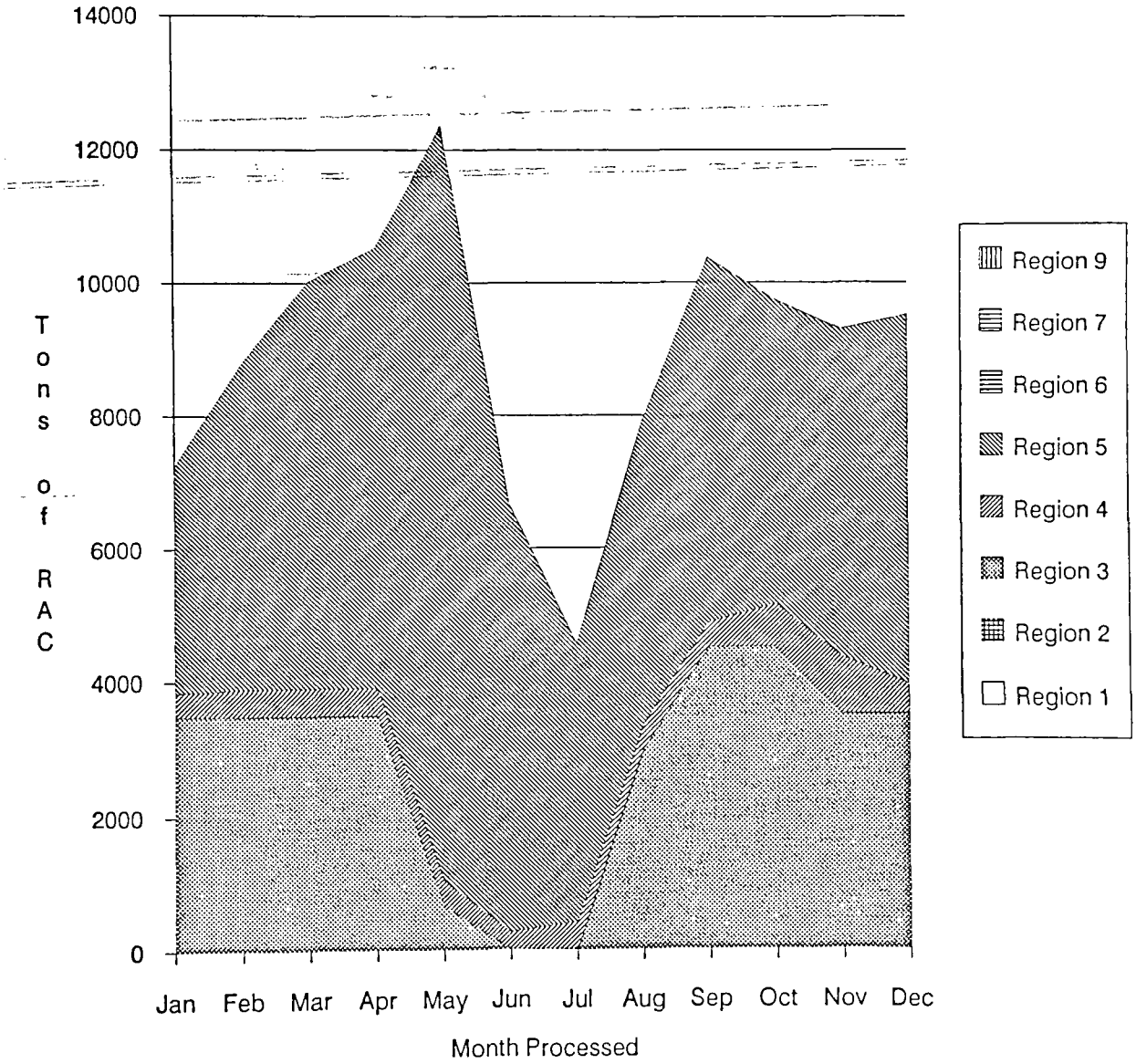


FIGURE A47. Processing Volume (tons/year) - Peanuts

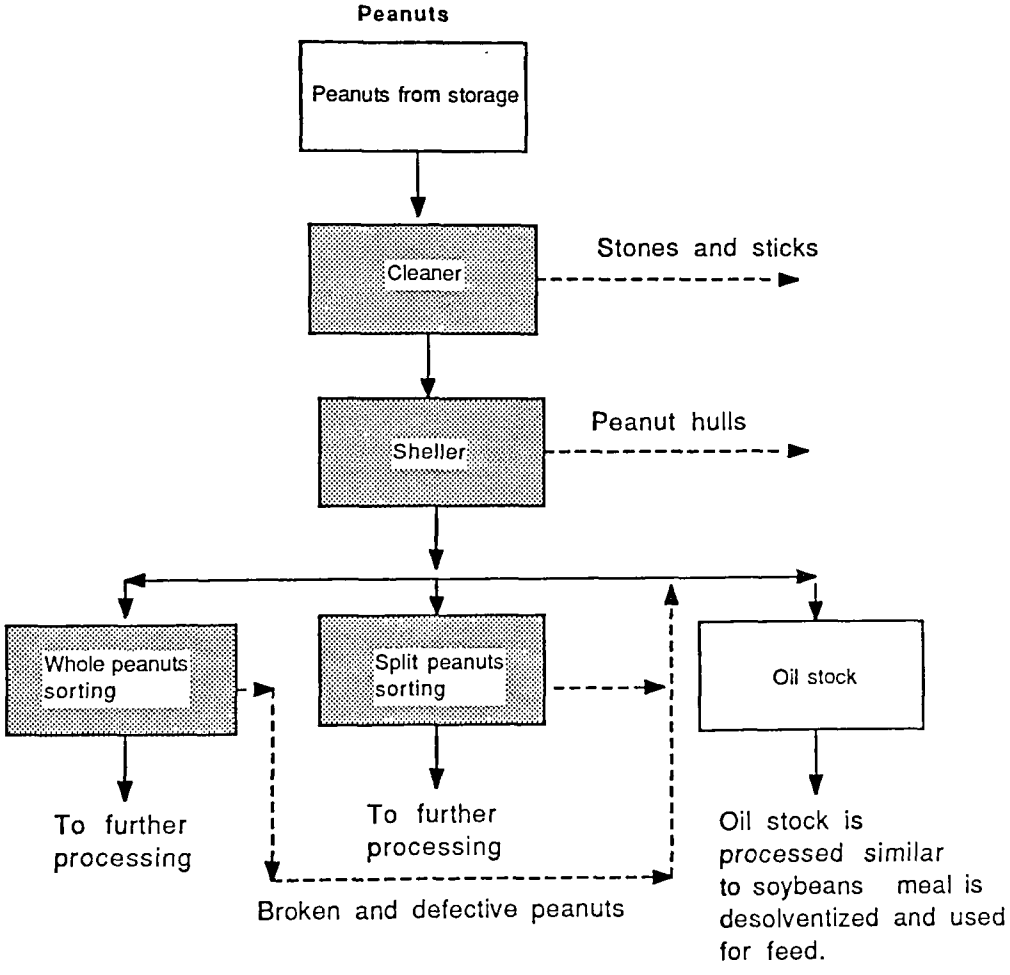


FIGURE A48. RAC Processing Flowsheet for Peanuts

COMMODITY: Pears

PRODUCTS MADE: Canned pears and fruit cocktail; blended fruit juice concentrates.

ANIMALS FED: Hogs and cattle.

PORTIONS FED: Processing for canning produces a waste stream composed of cores, peels, and culls. Processing for juice operations produces a pomace waste. Aggregate wet feed is 71 wt% m.c.

TABLE A49. RAC Utilization Profile for Pears

	Moisture Content (wt%)				RAC Utilization (see note a)			
Disposition	Min	Max	Mean	σ	Weight	Min	Max	Mean
RAC	81.0	91.0	85.6	3.8	294,804	235	70,759	24,567
Food Product	81.0	91.0	85.5	4.0	226,629	40%	81%	77%
Wet Feed	81.0	91.0	85.3	4.2	7,454	0%	43%	3%
Dry Feed	n.r.	n.r.	n.r.	n.r.	0	0%	0%	0%
Land Applied	84.0	89.0	86.5	2.5	25,730	0%	22%	9%
Land Filled	81.0	91.0	84.4	3.4	19,091	0%	100%	6%
Burned	n.r.	n.r.	n.r.	n.r.	0	0%	0%	0%
Other					16,474	0%	25%	6%
Unaccounted for					(573)			0%

note (a): Values are in wt% of total RAC, except RAC and weight figures, which are in total tons/year.
n.r. indicates that data was not reported by survey respondents.
() around data value indicates a negative mass balance error.

Processing Notes

Pears are stored under controlled atmosphere or in cold storage to lengthen the processing season. Prior to processing, they may be treated to promote further ripening (ripe pears tend to bruise very easily and are harvested slightly "early"). The ripened pears are sized, stripped of leaves, washed, and sorted. Top-grade pears are peeled and cored prior to cutting and canning. Peels, cores, and culls from the canning lines may be processed to produce pear juice, which is often blended with other juices. These wastes may also be land applied or landfilled.

Additional Comments

Presence of "stone cells" in pear pomace limits the feeding of pear pomace somewhat.

TABLE A50. Reported Processing Volume (tons/year) for Pears

Total Vol (tons/yr)	Processing Volume in Survey Region (tons RAC/yr)							
	1	2	3	4	5	6	7	9
294,804	0	0	0	3,957	5,940	0	125,775	159,132

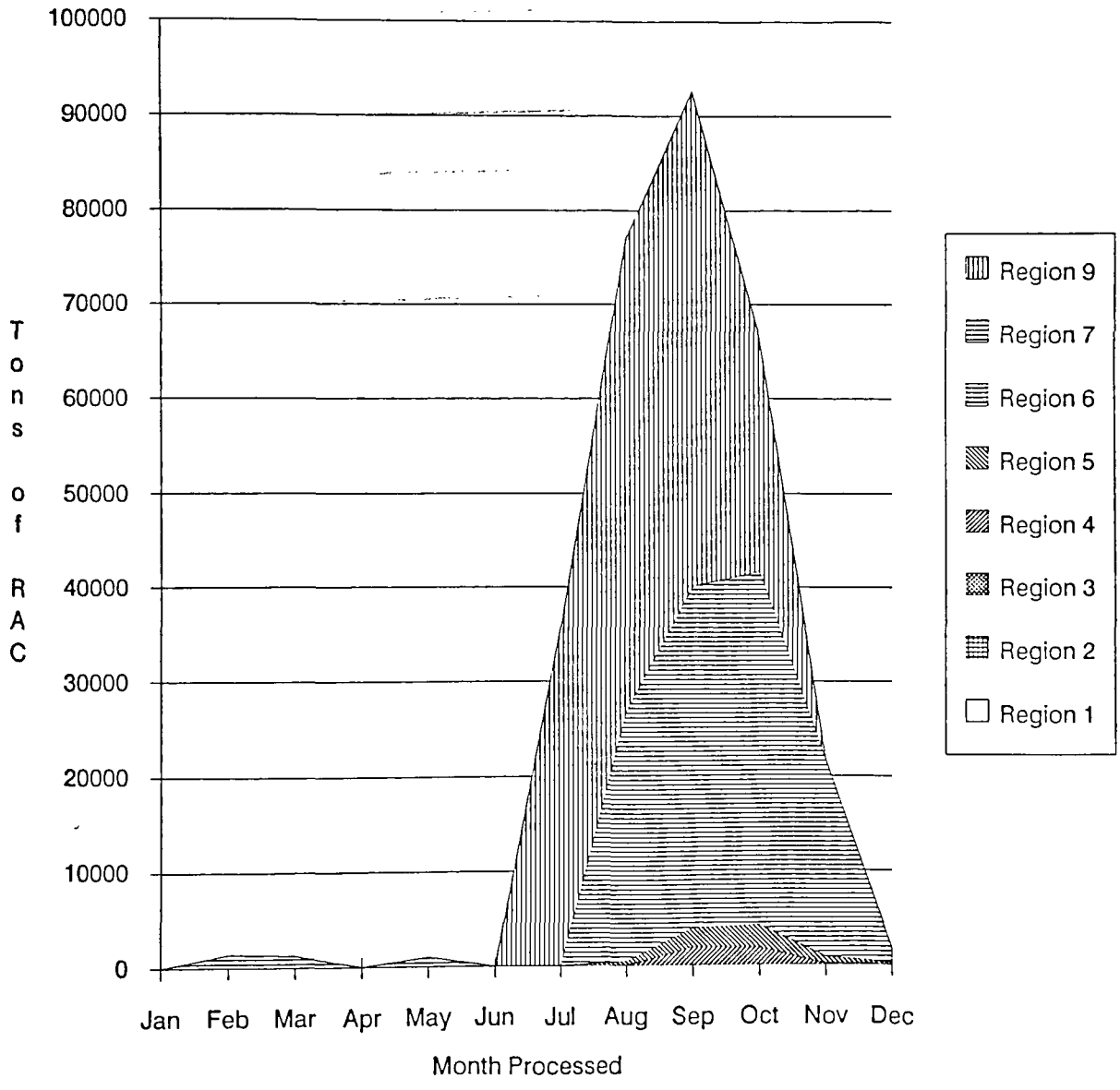


FIGURE A49. Processing Volume (tons/year) - Pears

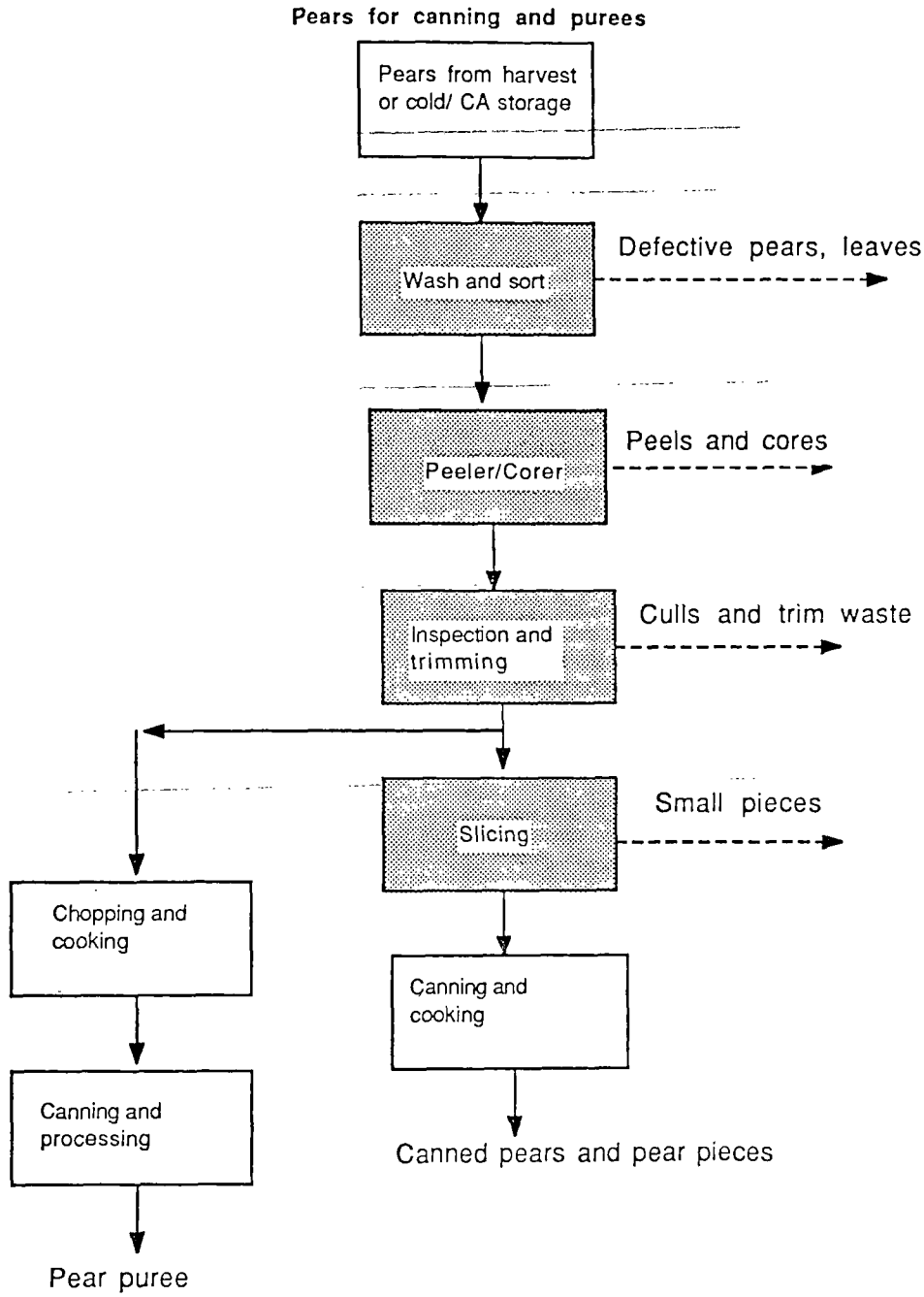


FIGURE A50. RAC Processing Flowsheet for Pears

COMMODITY: Peppers (includes Jalapeno, bell, Cascabel and Chili peppers)

PRODUCTS MADE: Specialty sauces and Salsas.

ANIMALS FED: Dairy cattle

PORTIONS FED: Peels and seeds

TABLE A51. RAC Utilization Profile for Peppers

	Moisture Content (wt%)				RAC Utilization (see note a)			
Disposition	Min	Max	Mean	σ	Weight	Min	Max	Mean
RAC	15.0	92.0	79.2	19.6	33,336	7	20,013	2,778
Food Product	15.0	92.0	77.8	22.5	22,411	39%	98%	67%
Wet Feed	92.0	92.0	92.0	0.0	5,604	0%	28%	17%
Dry Feed	n.r.	n.r.	n.r.	n.r.	0	0%	0%	0%
Land Applied	80.0	80.0	80.0	0.0	802	0%	11%	2%
Land Filled	80.0	90.0	84.1	2.6	4,197	0%	100%	13%
Burned	n.r.	n.r.	n.r.	n.r.	0	0%	0%	0%
Other					322	0%	20%	1%
Unaccounted for		-		-	0			0%

note (a): Values are in wt% of total RAC, except RAC and weight figures, which are in total tons/year.
n.r. indicates that data was not reported by survey respondents.
() around data value indicates a negative mass balance error.

Processing Notes

Harvested peppers are washed and sorted, with misshapen or defective peppers culled and sent to landfills. Depending on the type of pepper being processed, the pepper may be steam peeled prior to dicing and cooking/canning, or it may be processed with the peel. Some of the peppers are also processed through a finisher to extract seeds and other material, which may be landfilled, land applied, or fed to cattle.

TABLE A52. Reported Processing Volume (tons/year) for Peppers

Total Vol (tons/yr)	Processing Volume in Survey Region (tons RAC/yr)							
	1	2	3	4	5	6	7	9
33,336	Ø	Ø	Ø	155	28,678	Ø	Ø	4,503

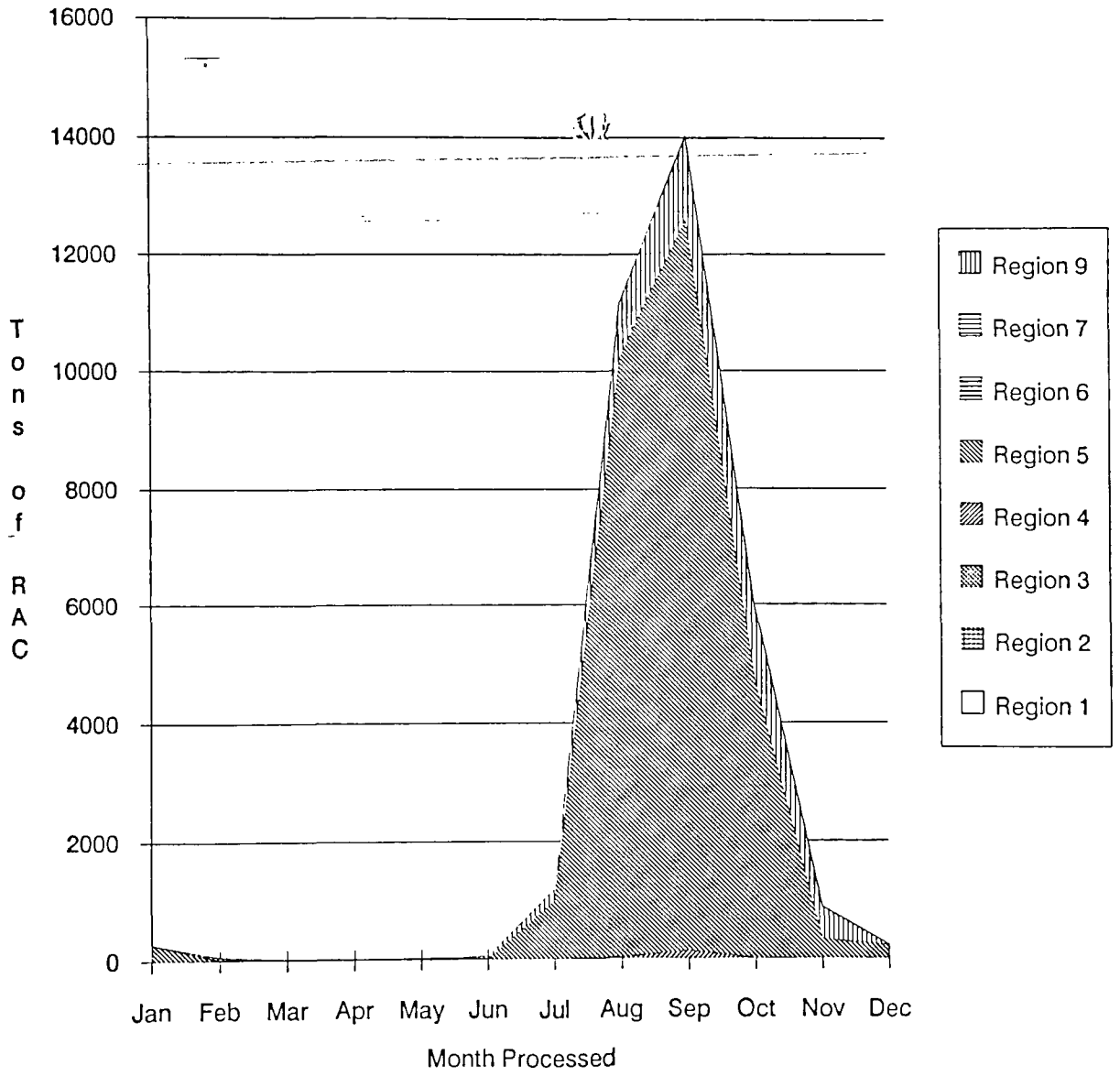


FIGURE A51. Processing Volume (tons/year) - Peppers

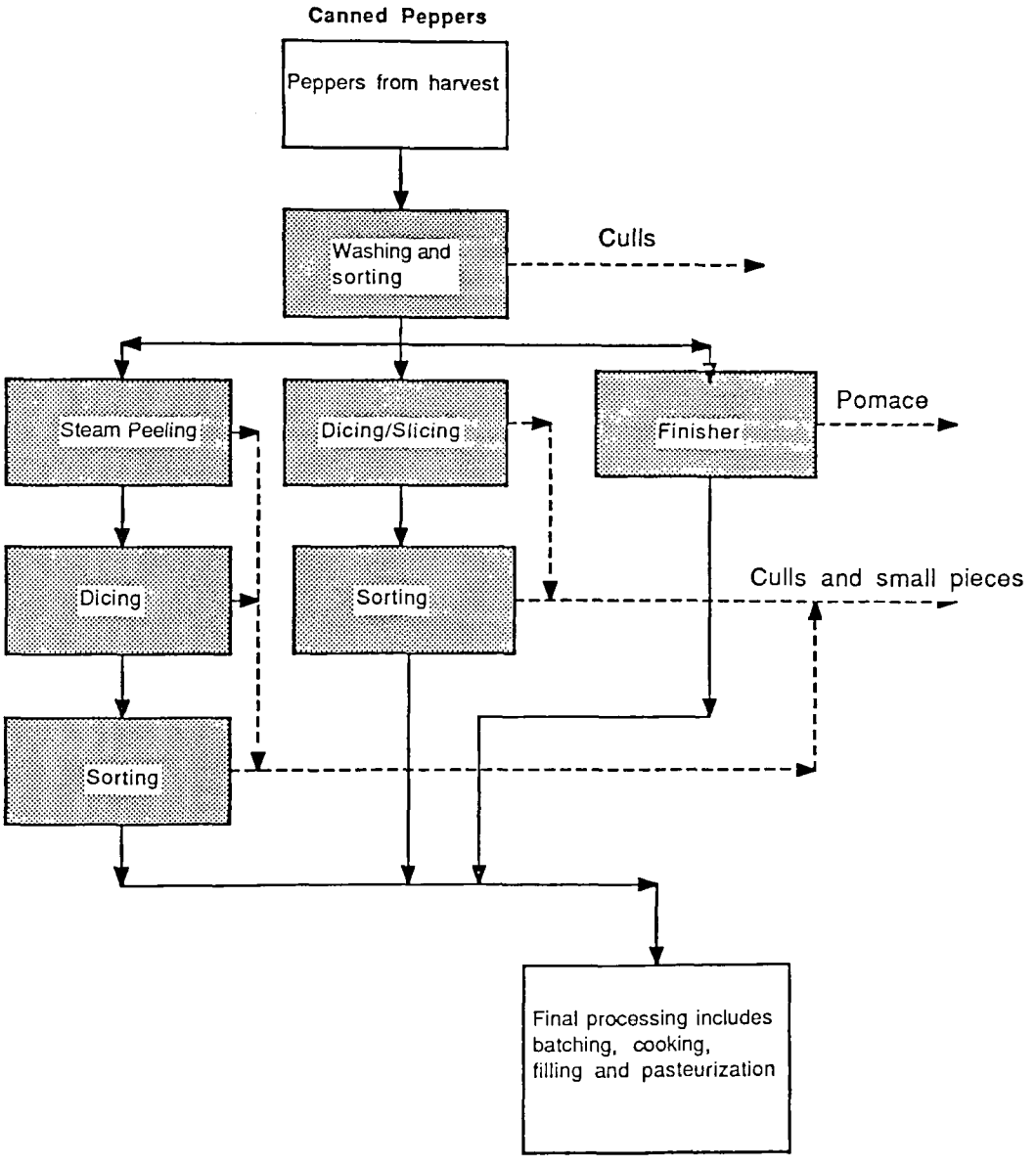


FIGURE A52. RAC Processing Flowsheet for Peppers

COMMODITY: Pineapple

PRODUCTS MADE: Canned sliced/chunked pineapple

ANIMALS FED: Beef cattle and goats

PORTIONS FED: Skins

TABLE A53. RAC Utilization Profile for Pineapple

	Moisture Content (wt%)				RAC Utilization (see note a)			
Disposition	Min	Max	Mean	σ	Weight	Min	Max	Mean
RAC	n.r.	n.r.	84.Ø	n.r.	214,65Ø	214,65Ø	214,65Ø	214,65Ø
Food Product	n.r.	n.r.	84.Ø	n.r.	184,599	n.r.	n.r.	86%
Wet Feed	n.r.	n.r.	84.Ø	n.r.	16,192	n.r.	n.r.	8%
Dry Feed	n.r.	n.r.	n.r.	n.r.	Ø	n.r.	n.r.	Ø%
Land Applied	n.r.	n.r.	n.r.	n.r.	Ø	n.r.	n.r	Ø%
Land Filled	n.r.	n.r.	84.Ø	n.r.	12,483	n.r.	n.r.	6%
Burned	n.r.	n.r.	n.r.	n.r.	Ø	n.r.	n.r.	Ø%
Other	-				1,376	n.r.	n.r.	1%
Unaccounted for		-			Ø			Ø%

note (a): Values are in wt% of total RAC, except RAC and weight figures, which are in total tons/year.
n.r. indicates that data was not reported by survey respondents.
() around data value indicates a negative mass balance error.

Processing Notes

Whole pineapples are sorted and mechanically cored to remove the skins which comprise the bulk of the solid wastes. The cored fruit is then further processed (usually sliced or chopped) prior to canning.

TABLE A54. Reported Processing Volume (tons/year) for Pineapples

Total Vol (tons/yr)	Processing Volume in Survey Region (tons RAC/yr)							
	1	2	3	4	5	6	7	9
214,650	0	0	0	0	0	0	0	214,650

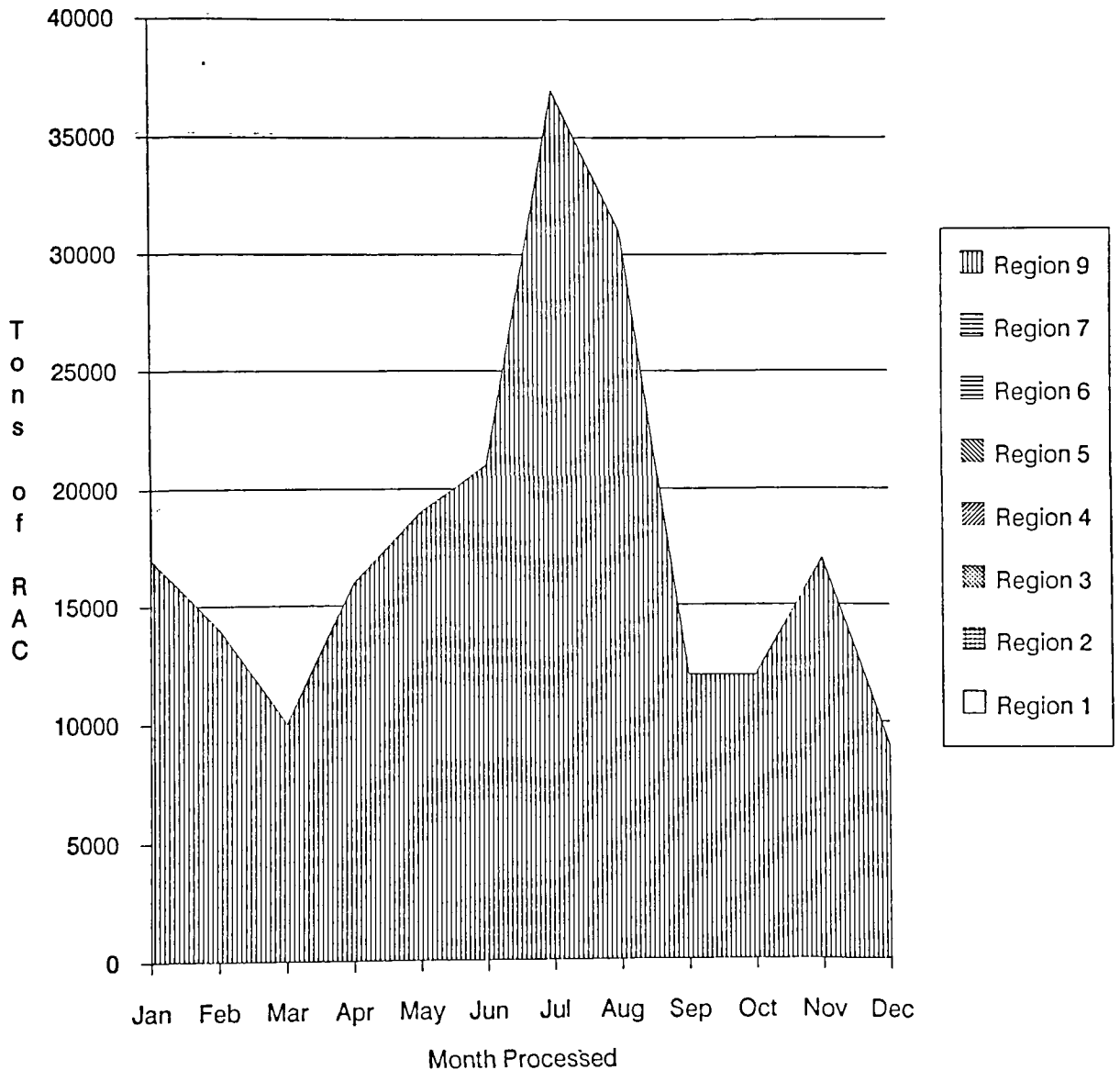


FIGURE A53. Processing Volume (tons/year) - Pineapples

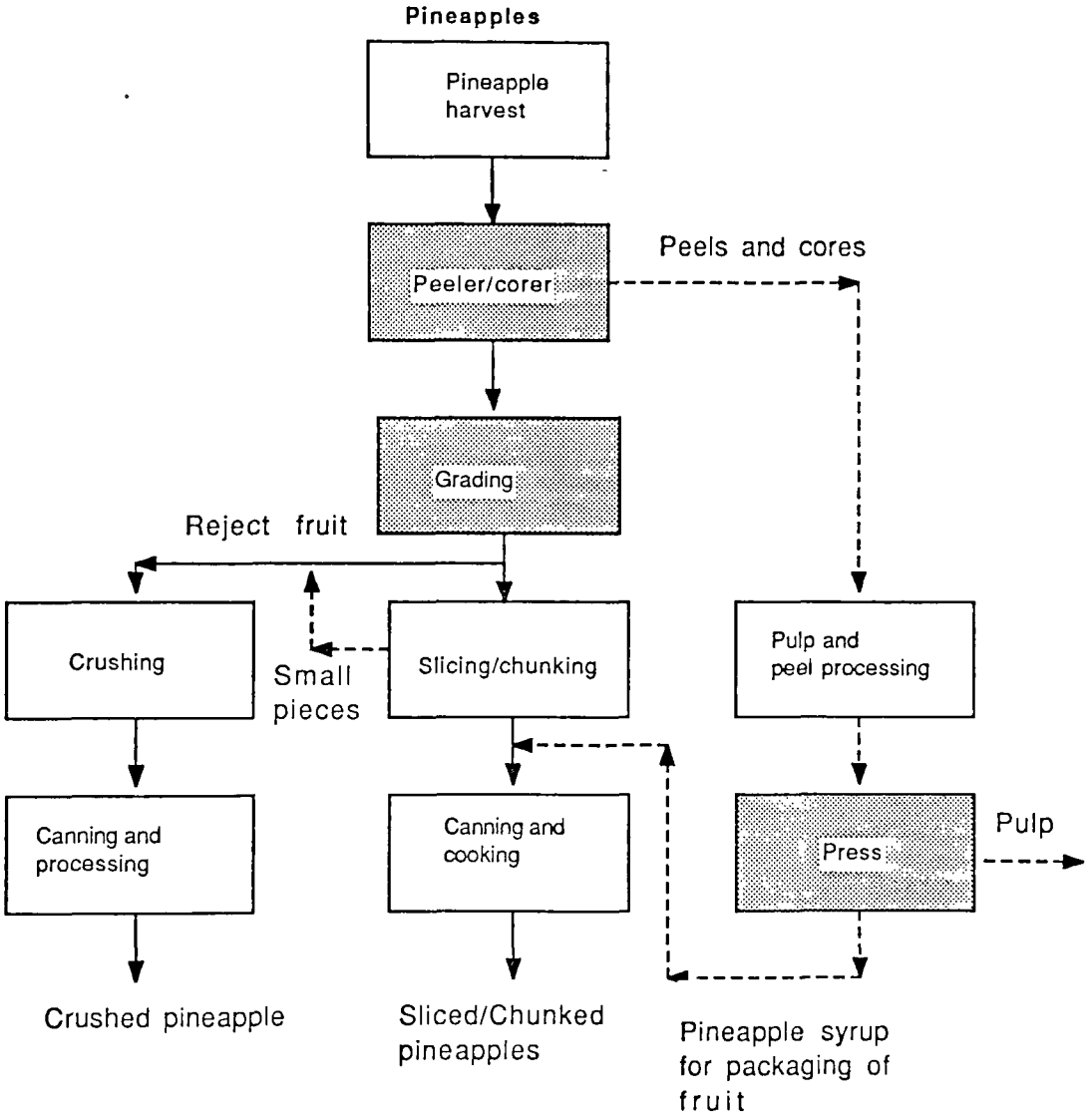


FIGURE A54. RAC Processing Flowsheet for Pineapple

COMMODITY: Potatoes

PRODUCTS MADE: Canned and frozen whole/sliced potatoes; dehydrated potatoes (instant mashed potatoes); frozen french fries and specialty potato products; stuffed potato skins; potato chips.

ANIMALS FED: Cattle (principally beef cattle); hogs; goats; mariculture.

PORTIONS FED: Wet waste (76 wt% m.c.) includes peels and peeling waste, fluming sludge and other settled solids from waste water; culls, trimmed portions, and water treatment sludge. Dry wastes constituted a much smaller portion (11 wt% m.c.) and included scrap and rejected product, recovered starch and dried wet waste.

TABLE A55. RAC Utilization Profile for Potatoes

	Moisture Content (wt%)				RAC Utilization (see note a)			
Disposition	Min	Max	Mean	σ	Weight	Min	Max	Mean
RAC	72.0	90.0	80.5	4.0	2,444,300	225	389,687	81,477
Food Product	0.0	90.0	76.3	17.4	1,164,628	14%	87%	48%
Wet Feed	0.0	90.0	77.1	18.0	621,902	0%	60%	25%
Dry Feed	0.0	85.0	70.8	26.8	89,178	0%	45%	4%
Land Applied	72.0	90.0	81.1	6.2	206,776	0%	142%	8%
Land Filled	72.0	78.5	76.4	2.6	7,215	0%	100%	0%
Burned	n.r.	n.r.	n.r.	n.r.	0	0%	0%	0%
Other	-		-		471,029	0%	87%	19%
Unaccounted for	-	-			(116,428)	-		-5%

note (a): Values are in wt% of total RAC, except RAC and weight figures, which are in total tons/year.
n.r. indicates that data was not reported by survey respondents.
() around data value indicates a negative mass balance error.

Processing Notes

Potatoes are shipped to processing plants stripped of vegetation. Primary source of processing waste is in the peeling operation, which can be by either steam peeling or caustic peeling methods. Other sources include culls, trimmed portions (ie, bruised areas, rot, green portions and other blemished portions). Potato processors also reported recovery of settled solids from washing and transport wastewater. These materials were generally not reported by other RAC processors in the survey.

TABLE A56. Reported Processing Volume (tons/year) for Potatoes

Total Vol (tons/yr)	Processing Volume in Survey Region (tons RAC/yr)							
	1	2	3	4	5	6	7	9
2,444,300	403,197	37,217	71,500	283,519	4,649	0	1,641,718	2,500

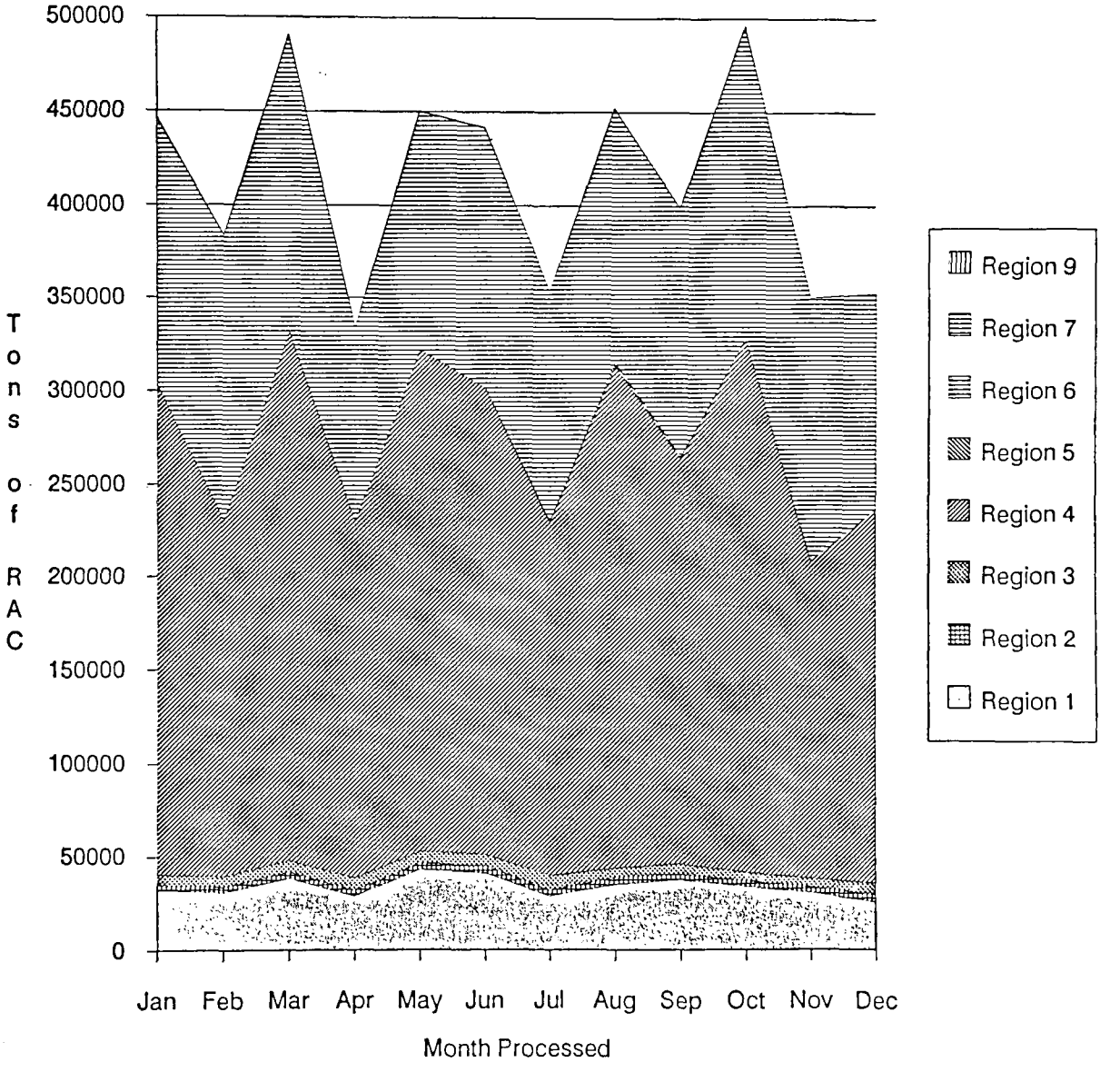


FIGURE A55. Processing Volume (tons/year) - Potatoes

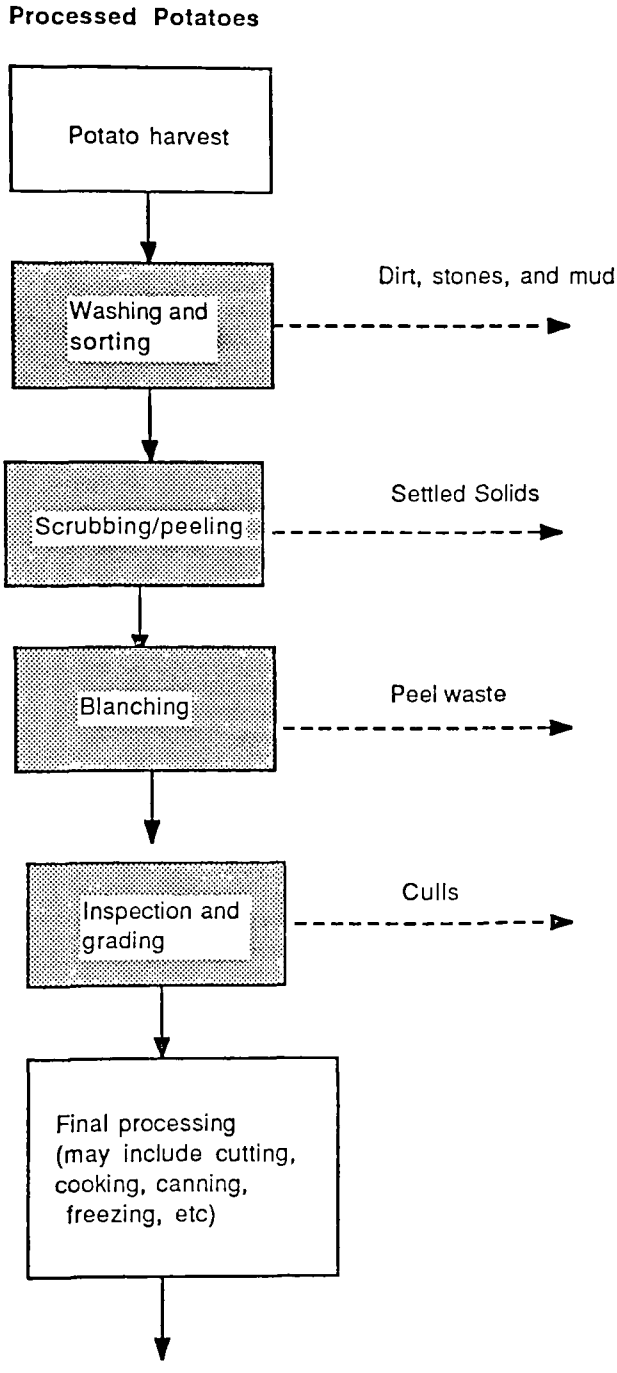


FIGURE A56. RAC Processing Flowsheet for Potatoes

COMMODITY: Prunes (dried, reconstituted, and ripe prunes and plums)

PRODUCTS MADE: Canned pitted prunes, dried prunes, and prune juice; canned and frozen plums.

ANIMALS FED: Cattle

PORTIONS FED: Whole prunes, pits, pulp (from juice operations).

TABLE A57. RAC Utilization Profile for Prunes and Plums

	Moisture Content (wt%)				RAC Utilization (see note a)			
Disposition	Min	Max	Mean	σ	Weight	Min	Max	Mean
RAC	16.0	81.0	39.6	28.1	93,841	575	53,642	8,531
Food Product	16.0	81.0	42.2	28.7	57,977	20%	97%	62%
Wet Feed	19.0	21.0	20.0	1.0	4,043	0%	34%	4%
Dry Feed	21.0	21.0	21.0	0.0	112	0%	4%	0%
Land Applied	21.0	21.0	21.0	0.0	73	0%	2%	0%
Land Filled	16.0	81.0	39.7	28.2	14,956	0%	100%	16%
Burned	n.r.	n.r.	n.r.	n.r.	500	0%	5%	1%
Other			-		16,279	0%	30%	17%
Unaccounted for					(100)			0%

note (a): Values are in wt% of total RAC, except RAC and weight figures, which are in total tons/year.
n.r. indicates that data was not reported by survey respondents.
() around data value indicates a negative mass balance error.

Processing Notes

Plums are graded, washed and either canned or used to make prunes. Prunes are plums which have been dehydrated, and may be canned or soaked in water to produce prune juice. The waste include pits, culls, and filter cake (pomace) from juicing operations. The wastes are landfilled, land applied, or fed. Relatively clean pits may be burned as fuel.

TABLE A58. Reported Processing Volume (tons/year) for Prunes

Total Vol (tons/yr)	Processing Volume in Survey Region (tons RAC/yr)							
	1	2	3	4	5	6	7	9
93,841	Ø	Ø	Ø	4,071	1,810	Ø	6,124	81,836

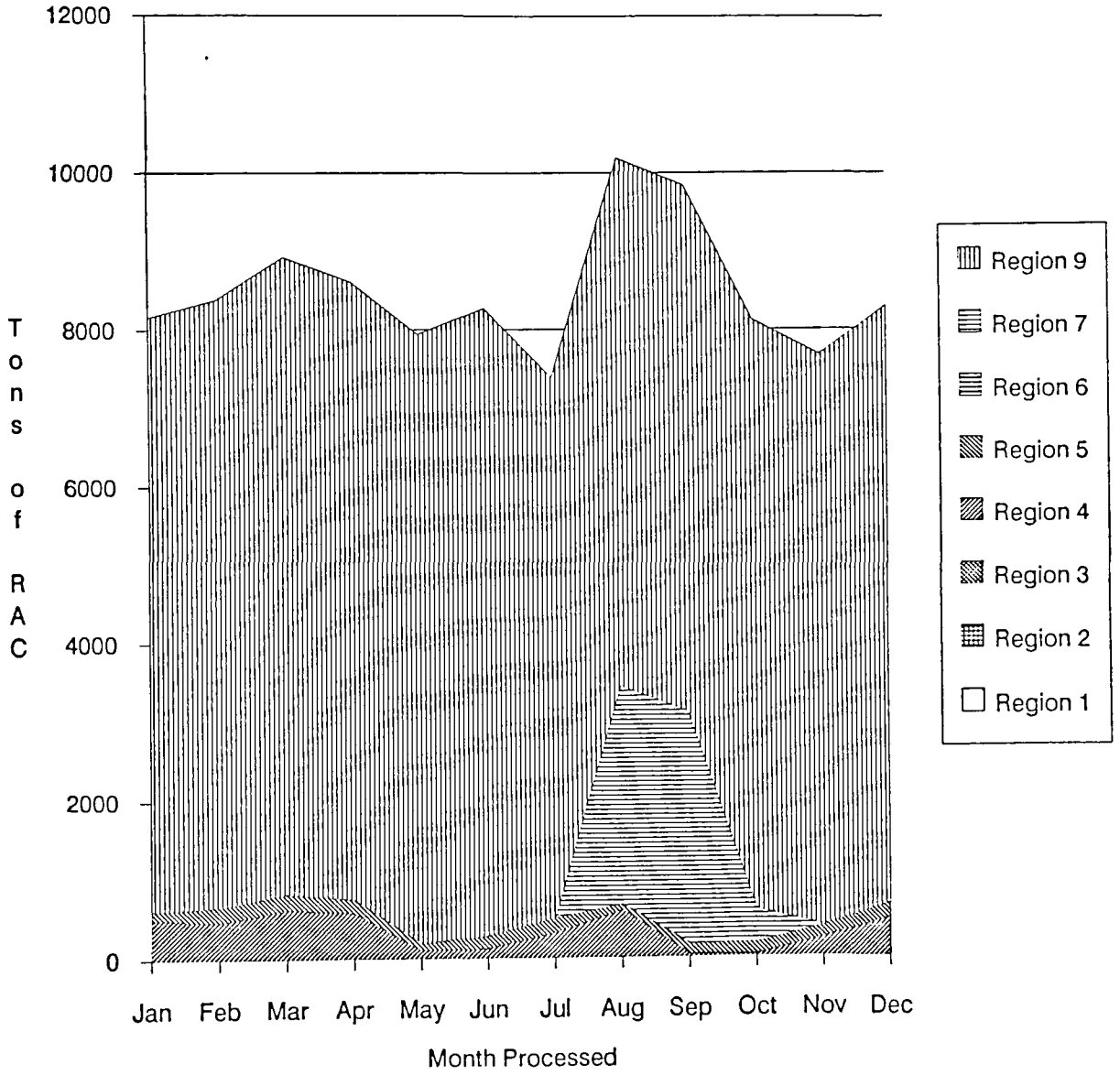


FIGURE A57. Processing Volume (tons/year) - Prunes

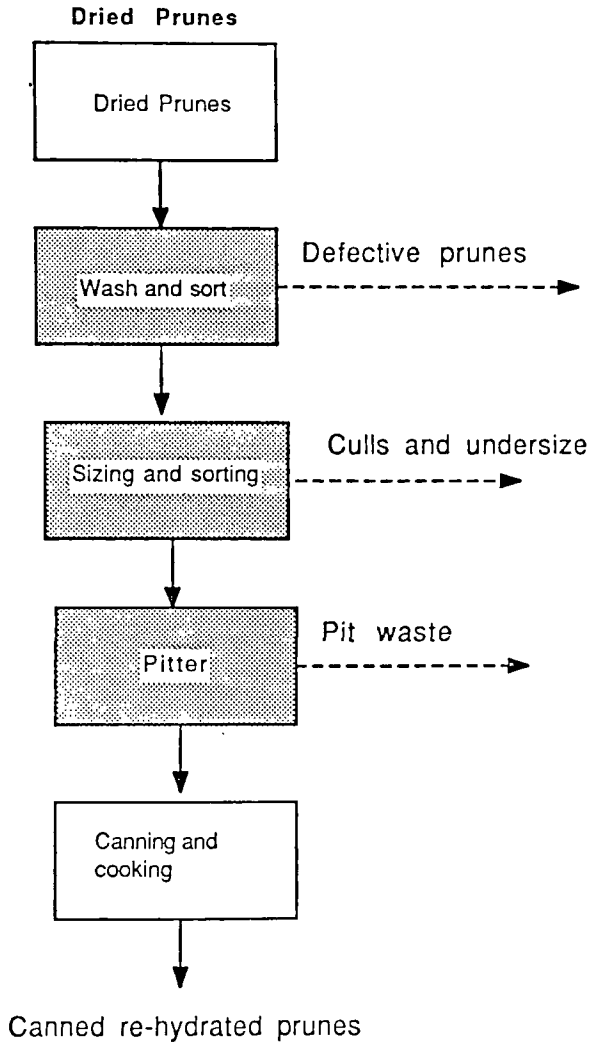


FIGURE A58. RAC Processing Flowsheet for Prunes and Plums

COMMODITY: Rice

PRODUCTS MADE: Rice reported in this category is restricted to rice use for milled (cleaned and hulled) rice for domestic consumption and does not include use for fermented beverages.

ANIMALS FED: Cattle, hogs, poultry

PORTIONS FED: Rice hulls and bran, broken grains.

TABLE A59. RAC Utilization Profile for Rice

	Moisture Content (wt%)				RAC Utilization (see note a)			
Disposition	Min	Max	Mean	σ	Weight	Min	Max	Mean
RAC	12.0	12.5	12.1	0.2	826,624	63,518	466,579	206,656
Food Product	12.0	12.5	12.1	0.2	539,091	55%	74%	65%
Wet Feed	n.r.	n.r.	n.r.	n.r.	0	0%	0%	0%
Dry Feed	12.0	12.5	12.1	0.2	190,458	5%	30%	23%
Land Applied	12.0	12.0	12.0	0.0	1,559	0%	1%	0%
Land Filled	12.0	12.0	12.0	0.0	4,199	0%	100%	1%
Burned	12.0	12.5	12.3	0.3	42,648	0%	20%	5%
Other	-			-	41,022	0%	16%	5%
Unaccounted for					7,647			1%

note (a): Values are in wt% of total RAC, except RAC and weight figures, which are in total tons/year
n.r. indicates that data was not reported by survey respondents.
() around data value indicates a negative mass balance error.

Processing Notes

Rough rice is screened to remove straw, stones and dirt prior to hulling. It is hulled by passing it through counter-rotating rubber rollers. The hulls, which make up 17-21 wt% of the weight of the rice () are used as feed, or burned (8 wt% m.c.) for process heat, or a variety of non-feed uses (including as a filter aid for fruit juice processing). The de-hulled rice is then further processed, which can include removal of the bran by rubbing the rice grains. The removed bran is aspirated and used as a feed material. The rice may also be further treated to brighten its color. Broken grains are separated by a variety of classifiers and are either fed or used in brewing.

TABLE A60. Reported Processing Volume (tons/year) for Rice

Total Vol (tons/yr)	Processing Volume in Survey Region (tons RAC/yr)							
	1	2	3	4	5	6	7	9
826,624	0	0	0	0	826,624	0	0	0

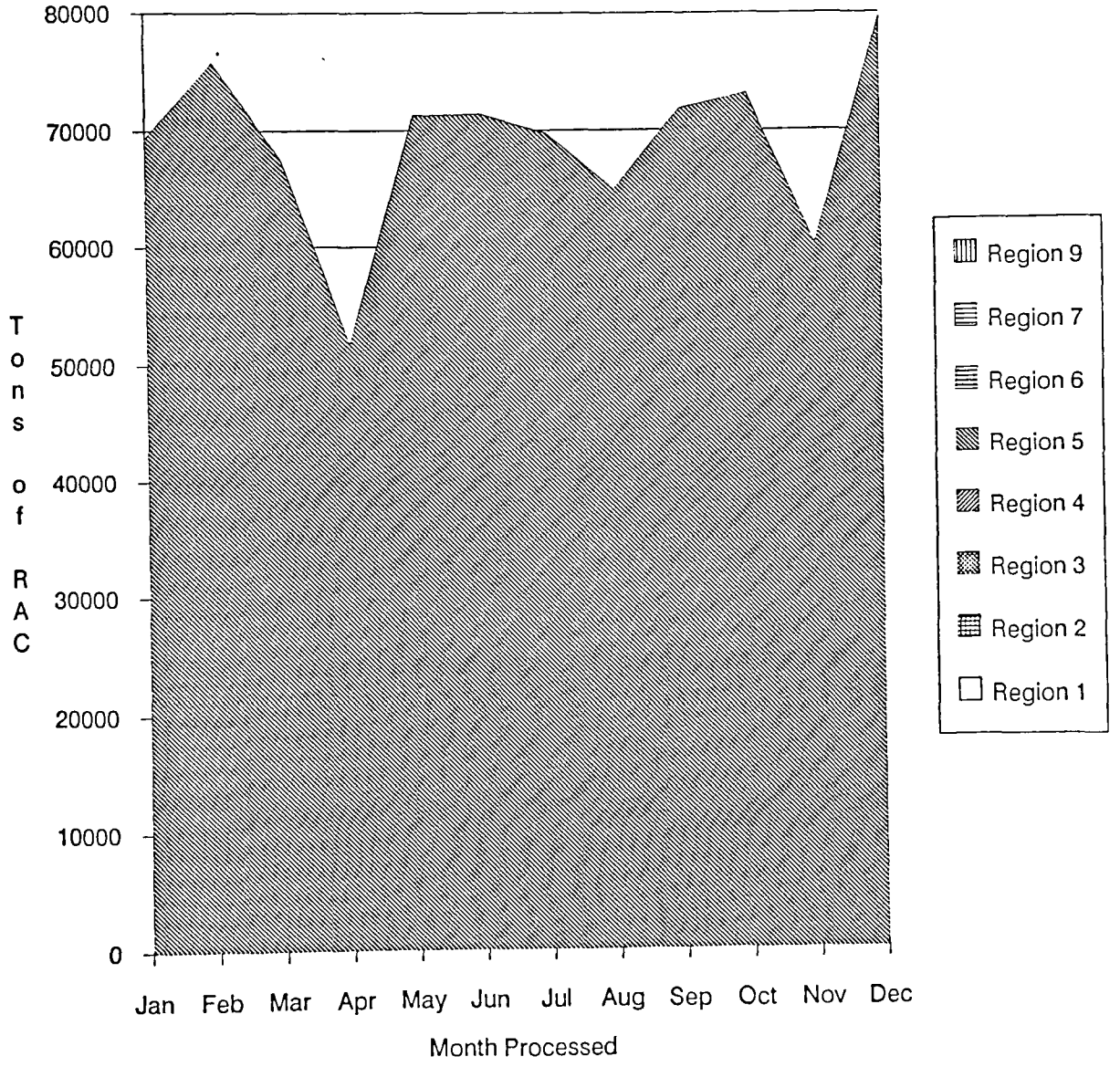


FIGURE A59. Processing Volume (tons/year) - Rice

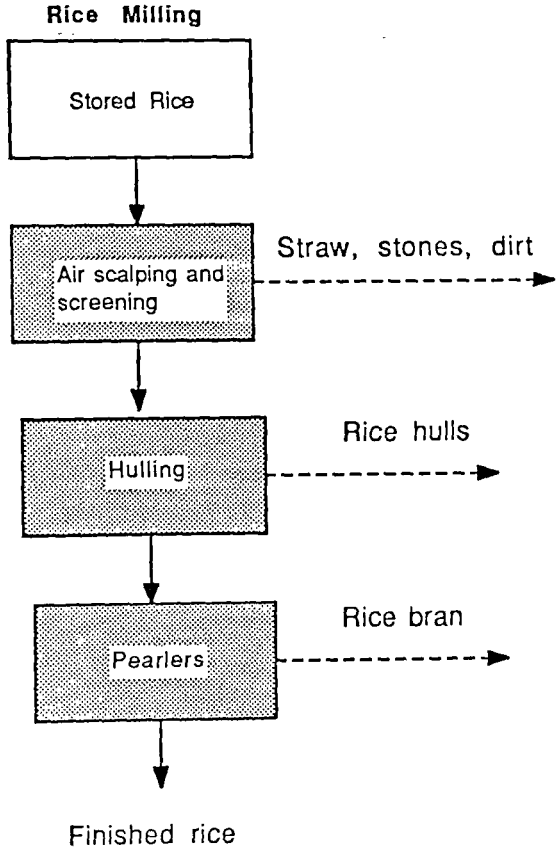


FIGURE A60. RAC Processing Flowsheet for Rice

COMMODITY: Shelled corn (dry milling and popcorn)

PRODUCTS MADE: Corn chips, corn flour, popcorn, corn starch and dried corn syrup

ANIMALS FED: Cattle, hogs, horses and poultry

PORTIONS FED: Husks, bran, germ, culls, scrap product and spills

TABLE A61. RAC Utilization Profile for Shelled Corn

	Moisture Content (wt%)				RAC Utilization (see note a)			
Disposition	Min	Max	Mean	σ	Weight	Min	Max	Mean
RAC	3.0	38.0	15.0	8.2	2,194,530	152	750,717	137,158
Food Product	3.0	38.0	14.0	7.7	803,928	0%	100%	37%
Wet Feed	12.0	38.0	19.8	10.3	7,621	0%	29%	0%
Dry Feed	3.0	38.0	15.8	8.1	648,636	0%	100%	30%
Land Applied	n.r	n.r.	n.r.	n.r.	0	0%	0%	0%
Land Filled	15.0	15.0	15.0	0.0	1,405	0%	100%	0%
Burned	n.r.	n.r.	n.r.	n.r.	0	0%	0%	0%
Other					569,731	0%	73%	26%
Unaccounted for	-				163,210			7%

note (a): Values are in wt% of total RAC, except RAC and weight figures, which are in total tons/year.
n.r. indicates that data was not reported by survey respondents.
() around data value indicates a negative mass balance error.

Processing Notes

Corn for dry milling may arrive at the processing plant either with or without husks. It is inspected, cleaned (either dry or wet), and treated to raise the moisture content prior to milling. In the milling process, germ is separated from the rest of the corn meal. Byproducts include cull ears and grains, germ and bran, scrap products (ie, corn chips). Husks and cobs may also be produced.

TABLE A62. Reported Processing Volume (tons/year) for Shelled corn

Total Vol (tons/yr)	Processing Volume in Survey Region (tons RAC/yr)							
	1	2	3	4	5	6	7	9
4,400,746	0	3,923	15,114	4,371,337	372	0	10,000	0

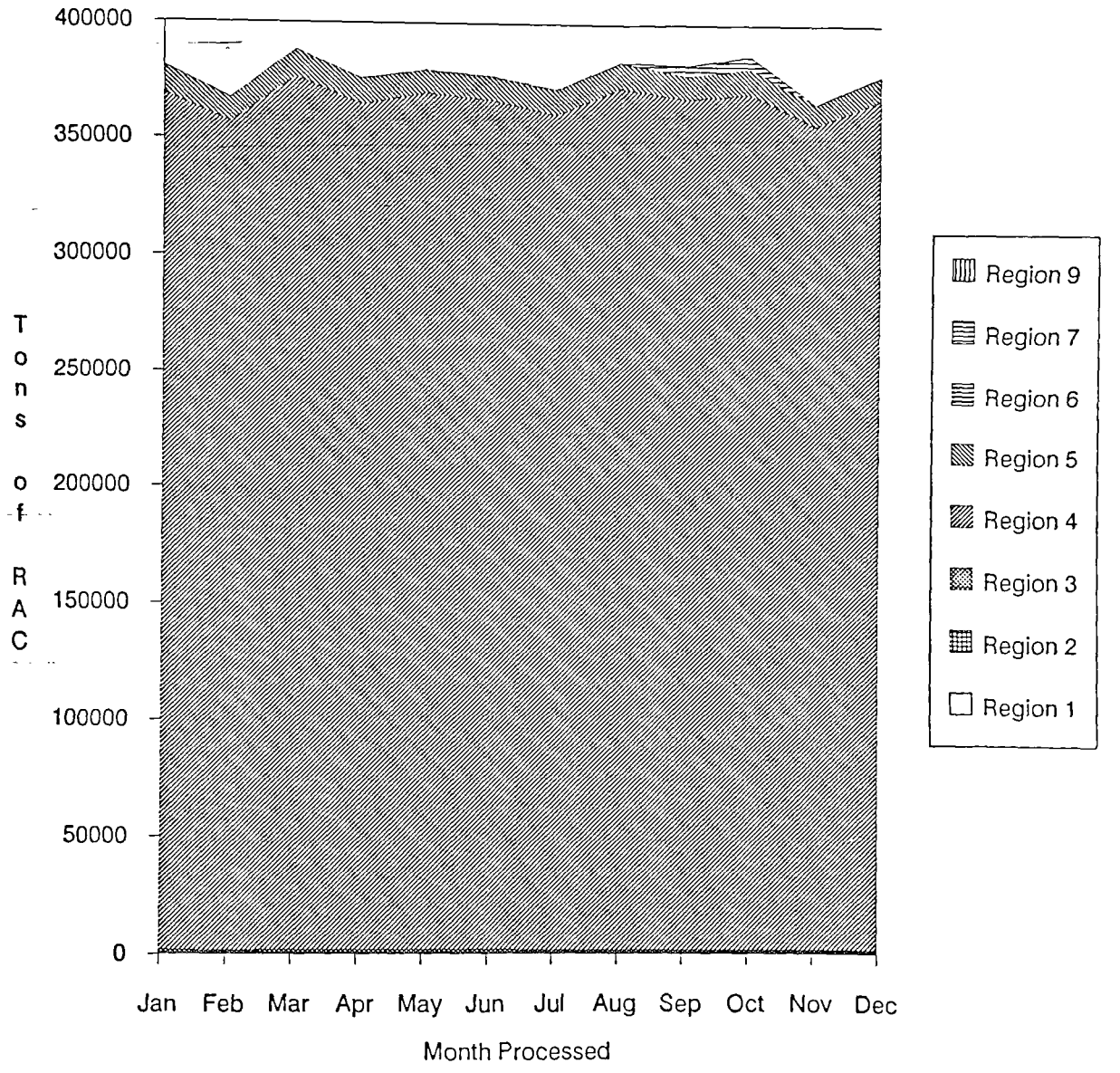


FIGURE A61. Processing Volume (tons/year) - Shelled corn

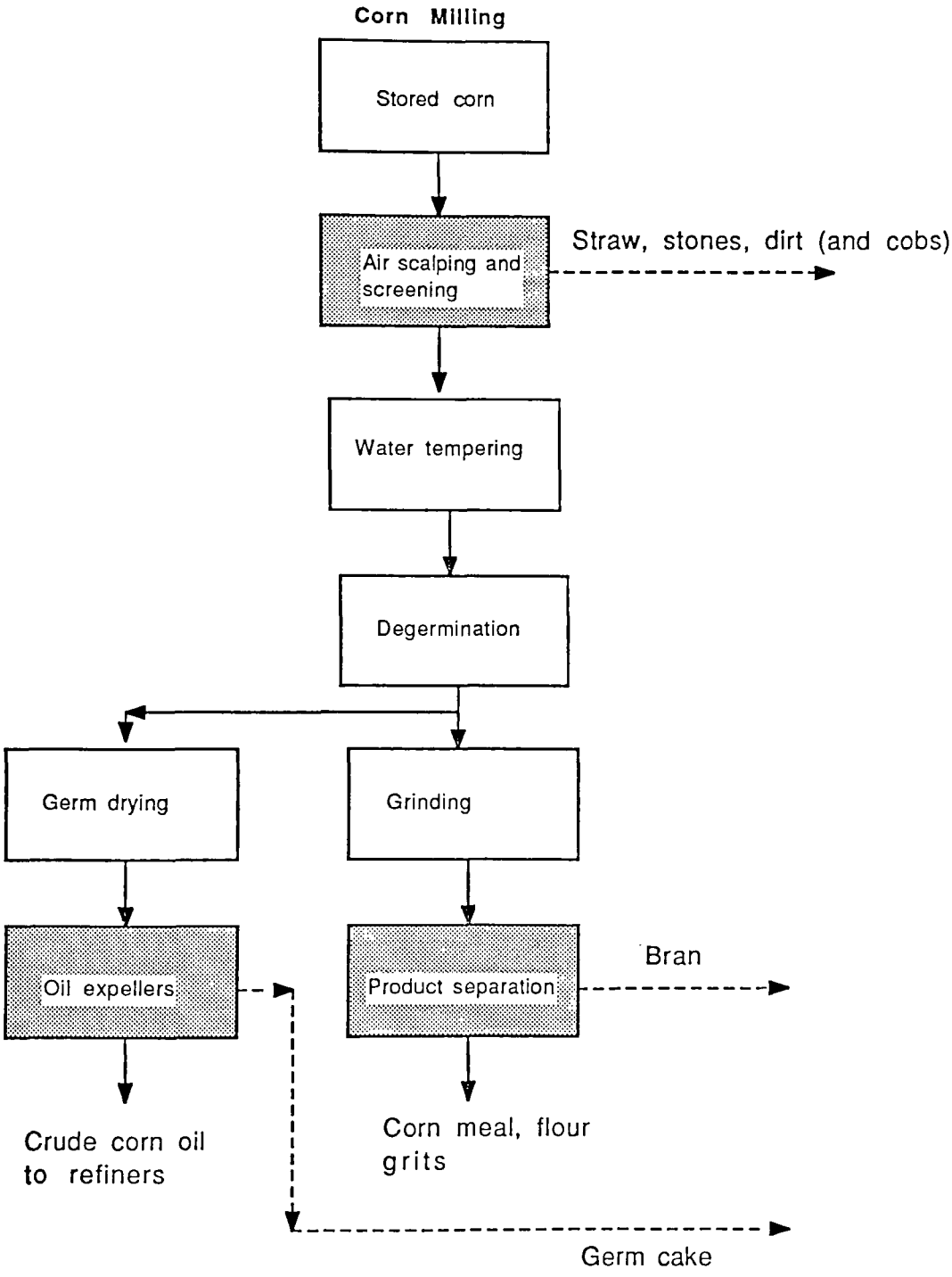


FIGURE A62. RAC Processing Flowsheet for Shelled Corn

COMMODITY: Soybeans

PRODUCTS MADE: Soy oil, soy flour, lecithin.

ANIMALS FED: Poultry, cattle, hogs.

PORTIONS FED: Extracted soy meal (from oil extraction); hulls, flour and spillage.

TABLE A63. RAC Utilization Profile for Soybeans

	Moisture Content (wt%)				RAC Utilization (see note a)			
Disposition	Min	Max	Mean	σ	Weight	Min	Max	Mean
RAC	8.0	13.0	11.9	1.5	4,698,623	2,760	675,000	361,433
Food Product	0.0	13.0	10.4	4.0	849,083	0%	99%	18%
Wet Feed	13.0	13.0	13.0	0.0	400	0%	0%	0%
Dry Feed	0.0	13.0	10.8	3.6	3,702,269	0%	82%	79%
Land Applied	n.r	n.r.	n.r.	n.r.	15	0%	0%	0%
Land Filled	12.0	13.0	12.7	0.5	2,773	0%	100%	0%
Burned	13.0	13.0	13.0	0.0	5,080	0%	2%	0%
Other	-	-			130,330	0%	30%	3%
Unaccounted for				-	(8,673)			0%

note (a): Values are in wt% of total RAC, except RAC and weight figures, which are in total tons/year
n.r. indicates that data was not reported by survey respondents.
() around data value indicates a negative mass balance error.

Processing Notes

Soy beans are air scalped and screened to remove foreign material and small beans, then pressed in a roller mill to separate the seed from the hull. The rolled beans are aspirated to remove the hulls, and solvent extracted to remove the oil, which is the primary food product. The main sources of byproduct are the hulls and the meal (11 wt% m.c.), although spillage of whole beans is generally included in the portion that goes to the feedlot. Trash from the air scalper (12 wt% m.c.) consists of beans and dirt, small stems and other plant material ("stick waste") and sweepings from the processing plant.

Additional Notes

Processed soy meal is actually nutritionally enhanced with respect to the raw beans when used for livestock feed.

TABLE A64. Reported Processing Volume (tons/year) for Soybeans

Total Vol (tons/yr)	Processing Volume in Survey Region (tons RAC/yr)							
	1	2	3	4	5	6	7	9
4,314,215	0	0	240,000	3,813,312	260,903	0	0	0

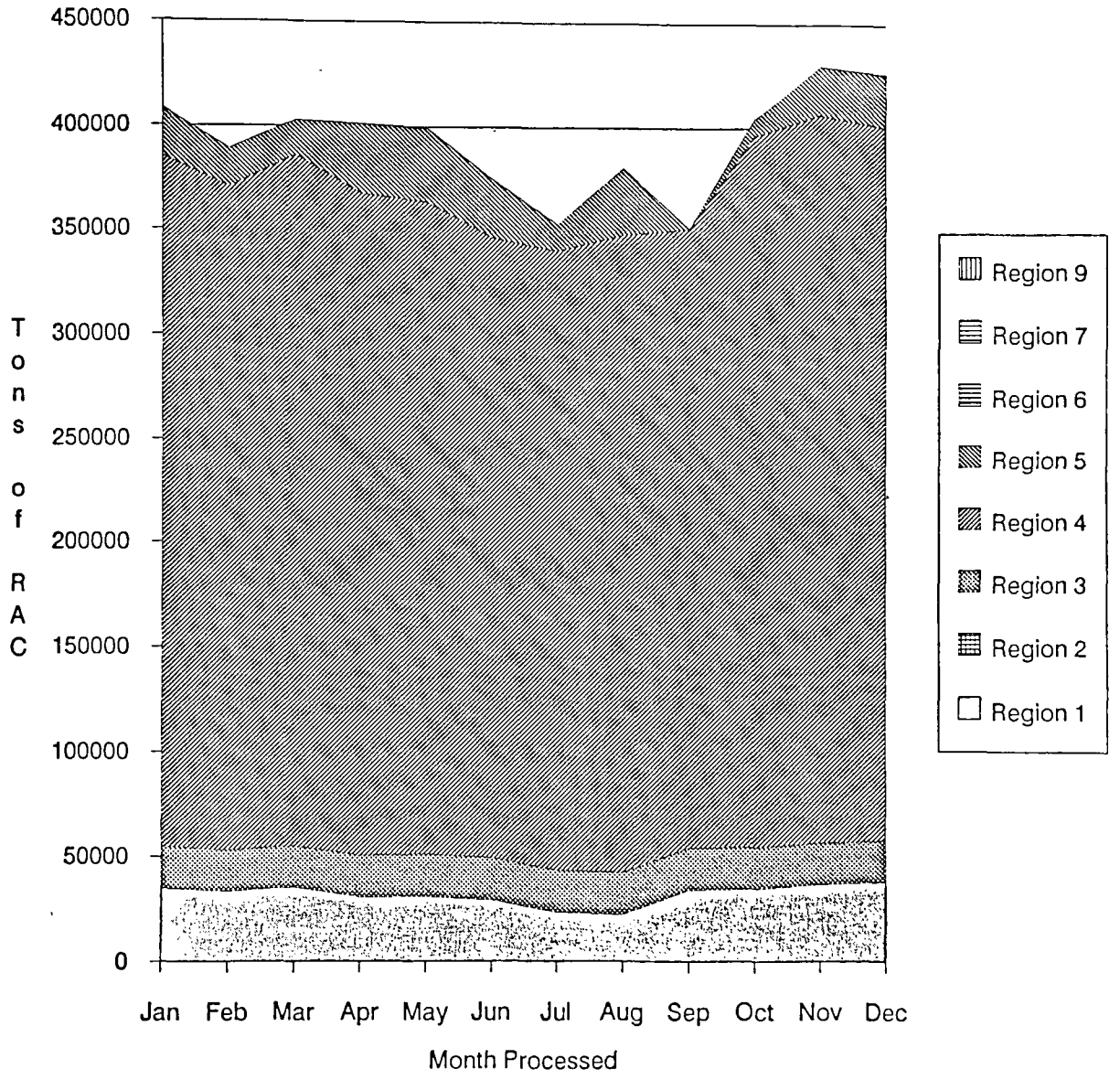


FIGURE A63. Processing Volume (tons/year) - Soybeans

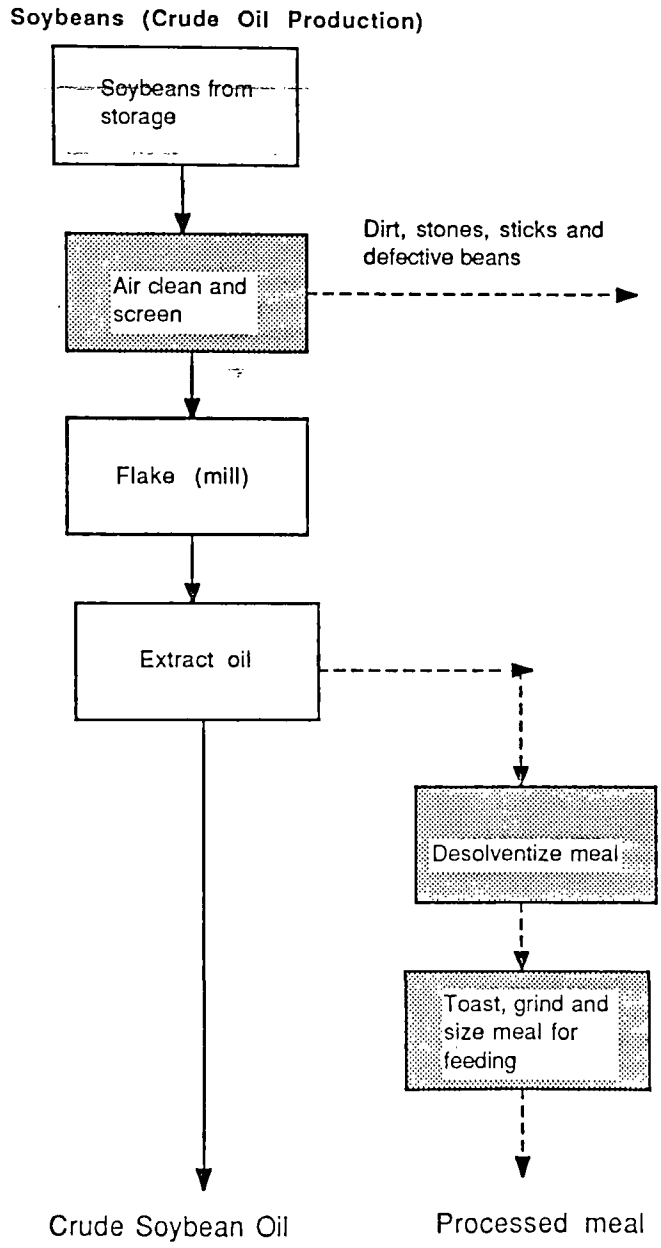


FIGURE A64. RAC Processing Flowsheet for Soybeans

COMMODITY: Squash (includes Zucchini , yellow squash, and pumpkins)

PRODUCTS MADE: Canned and frozen squash slices; canned pumpkin products (ie, pumpkin pie filling)

ANIMALS FED: Beef cattle; sheep; hogs.

PORTIONS FED: Squash ends, green squash, and decayed material

TABLE A65. RAC Utilization Profile for Squash

	Moisture Content (wt%)				RAC Utilization (see note a)			
Disposition	Min	Max	Mean	σ	Weight	Min	Max	Mean
RAC	82.Ø	96.Ø	9Ø.Ø	4.8	44,719	3Ø	25,ØØ5	4,969
Food Product	82.Ø	96.Ø	9Ø.3	6.Ø	38,256	63%	96%	86%
Wet Feed	82.Ø	93.Ø	87.5	5.5	3,861	Ø%	34%	9%
Dry Feed	n.r.	n.r.	n.r.	n.r.	195	Ø%	17%	Ø%
Land Applied	82.Ø	82.Ø	82.Ø	Ø.Ø	1,Ø55	Ø%	6%	2%
Land Filled	96.Ø	96.Ø	96.Ø	Ø.Ø	1,2Ø8	Ø%	1ØØ%	3%
Burned	n.r.	n.r.	n.r	n.r.	Ø	Ø%	Ø%	Ø%
Other					145	Ø%	1%	Ø%
Unaccounted for	-				(Ø)			Ø%

note (a): Values are in wt% of total RAC, except RAC and weight figures, which are in total tons/year.
n.r. indicates that data was not reported by survey respondents.
() around data value indicates a negative mass balance error.

Processing Notes

Processing of squash follows the usual canning/freezing steps of washing, sorting/grading, blanching and packing (or freezing). Wastes are primarily derived from the sorting operation, although most processors reported that a portion of the squash (the vine end) is cut and discarded at the processing plant.

TABLE A66. Reported Processing Volume (tons/year) for Squash

Total Vol (tons/yr)	Processing Volume in Survey Region (tons RAC/yr)							
	1	2	3	4	5	6	7	9
44,719	0	0	0	2,801	4,870	0	9,130	27,918

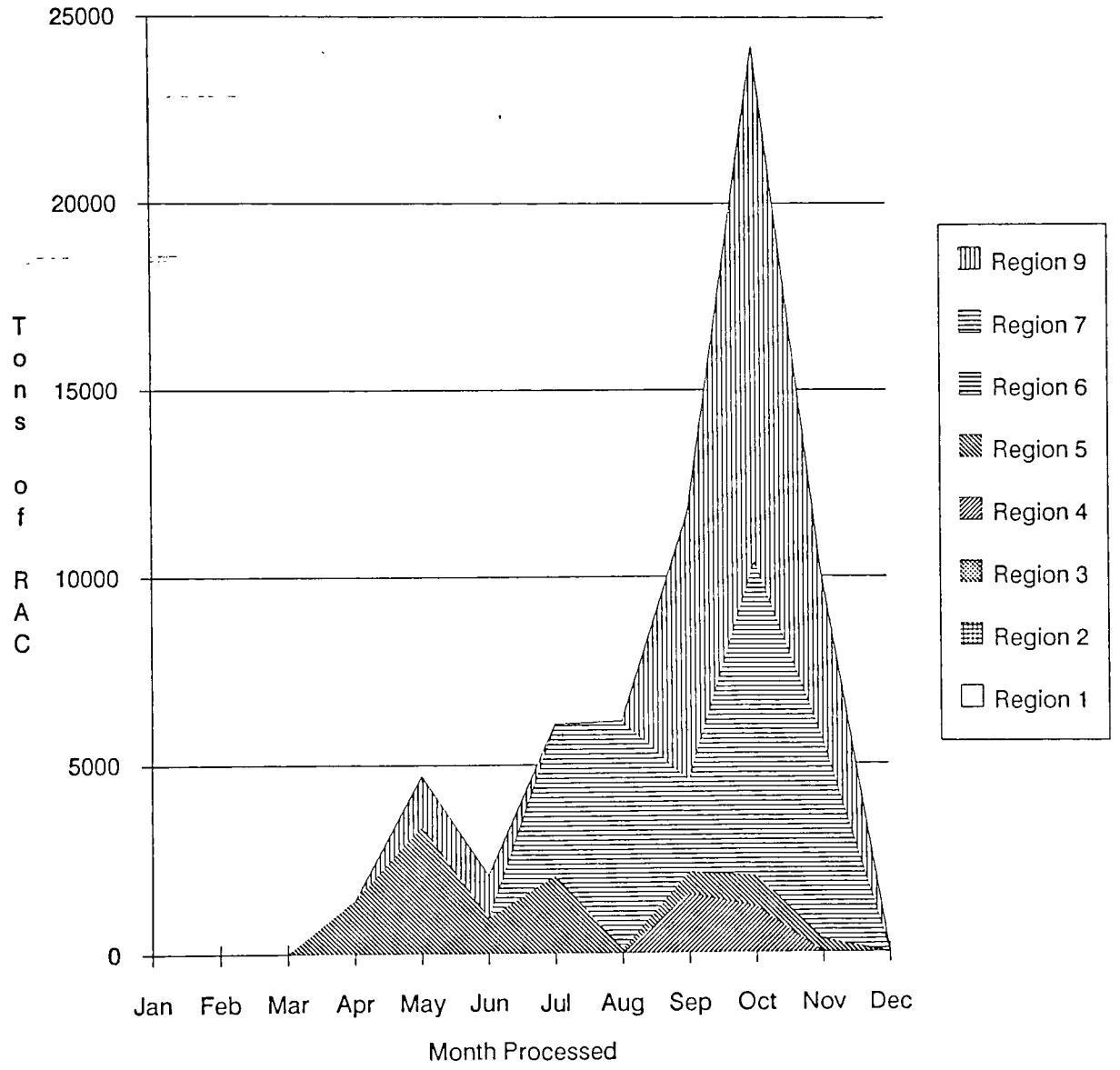


FIGURE A65. Processing Volume (tons/year) - Squash

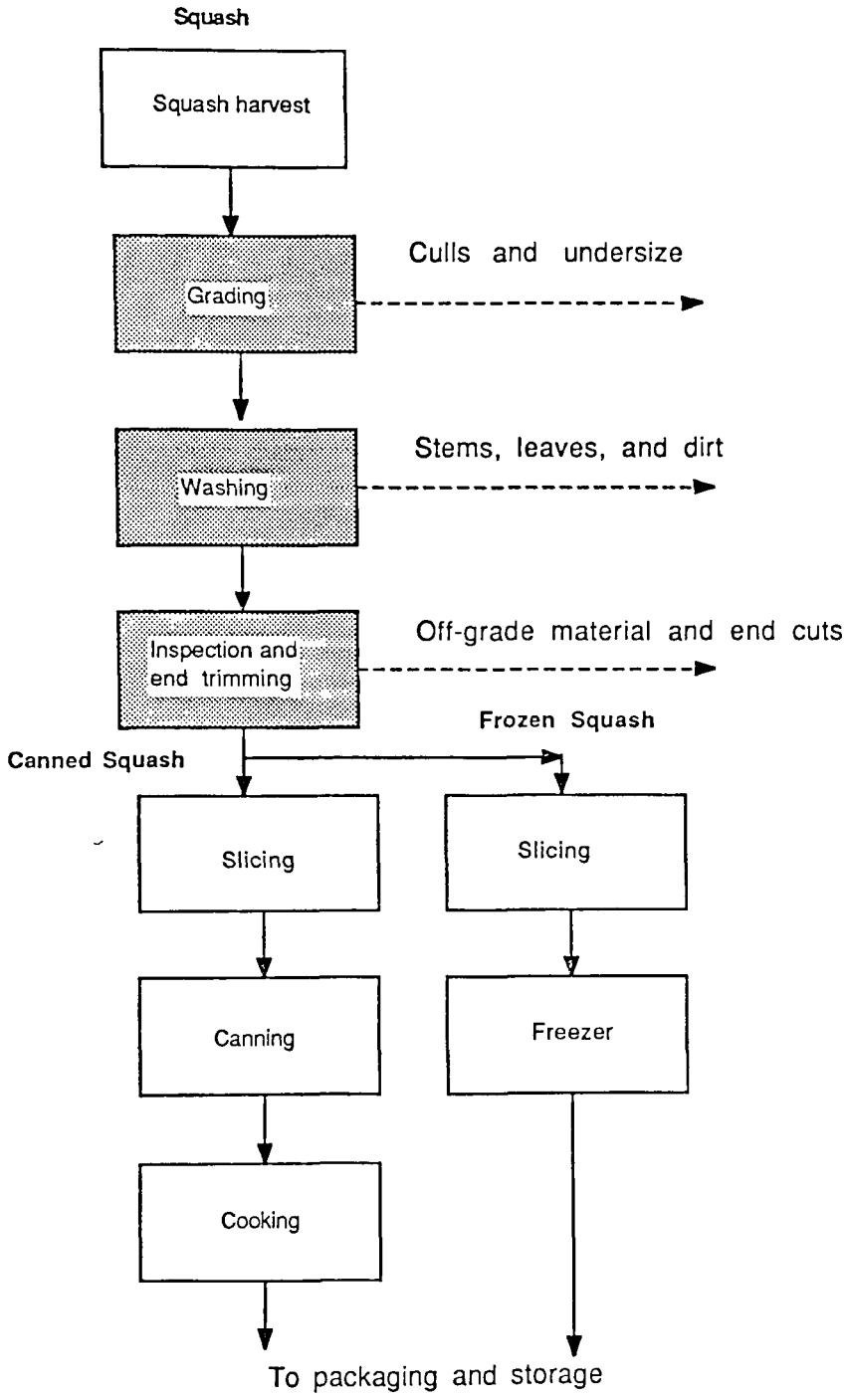


FIGURE A66. RAC Processing Flowsheet for Squash

COMMODITY: Sugar beets.

PRODUCTS MADE: Refined sugar.

ANIMALS FED: Primarily beef cattle; also hogs and goats.

PORTIONS FED: Tops, leaves, beetchips and wet pulp are fed as a wet byproduct (79 wt% m.c.); molasses is sometimes blended with these materials for feeding purposes. Dried beet pulp (12-15 wt% m.c.) is also fed.

TABLE A67. RAC Utilization Profile for Sugar Beets

	Moisture Content (wt%)				RAC Utilization (see note a)			
Disposition	Min	Max	Mean	σ	Weight	Min	Max	Mean
RAC	15.0	82.0	76.9	15.5	10,972,597	37,357	1,028,113	609,589
Food Product	n.r.	n.r.	n.r.	n.r.	1,384,018	11%	33%	13%
Wet Feed	15.0	80.0	71.6	21.4	240,635	0%	63%	2%
Dry Feed	0.0	82.0	76.0	19.0	619,750	0%	7%	6%
Land Applied	15.0	80.0	70.4	22.6	6,269	0%	0%	0%
Land Filled	80.0	80.0	80.0	0.0	6,000	0%	100%	0%
Burned	n.r.	n.r.	n.r.	n.r.	0	0%	0%	0%
Other	-		-		7,031,251(b)	0%	83%	64%
Unaccounted for	-		-		1,684,675(b)	-	-	15%

note (a): Values are in wt% of total RAC, except RAC and weight figures, which are in total tons/year.
n.r. indicates that data was not reported by survey respondents.
() around data value indicates a negative mass balance error.

(b): Large "Other" and "Unaccounted" weights represent moisture losses during processing of sugar beets. "Other" results from processors who reported this loss as a line item; "Unaccounted" results from those who did not itemize the moisture losses.

Processing Notes

Incoming sugar beets are topped and trimmed and washed prior to being extracted. Extraction is facilitated by slicing the beet into strips which are then soaked in water to remove the sugar content. The pulp which remains is the principal byproduct stream, and contains a mean m.c. of 80 wt%. The pulp is sometimes dried to approximately 12-15 wt% m.c. prior to being sold as cattle feed. Both the wet and dry pulp may be mixed with molasses (from the sugar refining process) prior to being fed. The large unaccounted for material is unreported moisture losses (not all beet processors reported moisture loss data on the survey).

Discrepancies in the reported mean moisture content of the "Dry Feed" are due to inconsistencies in processor's classification of these materials. No attempt was made to correct this classification while tabulating the results.

TABLE A68. Reported Processing Volume (tons/year) for Sugar beets

Total Vol (tons/yr)	Processing Volume in Survey Region (tons RAC/yr)							
	1	2	3	4	5	6	7	9
10,972,597	0	0	0	3,144,491	805,000	1,618,784	0	5,404,322

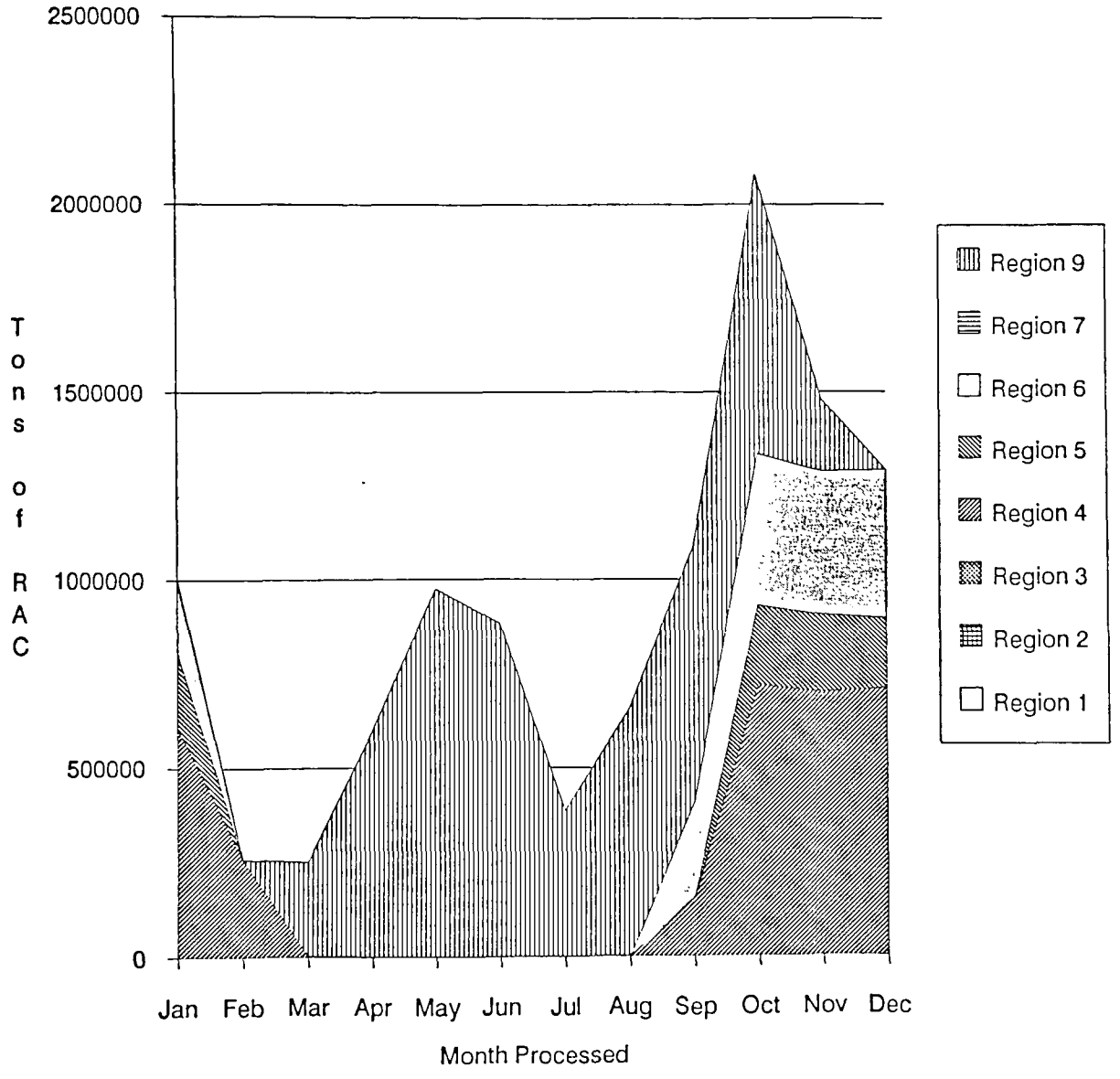


FIGURE A67. Processing Volume (tons/year) - Sugar beets

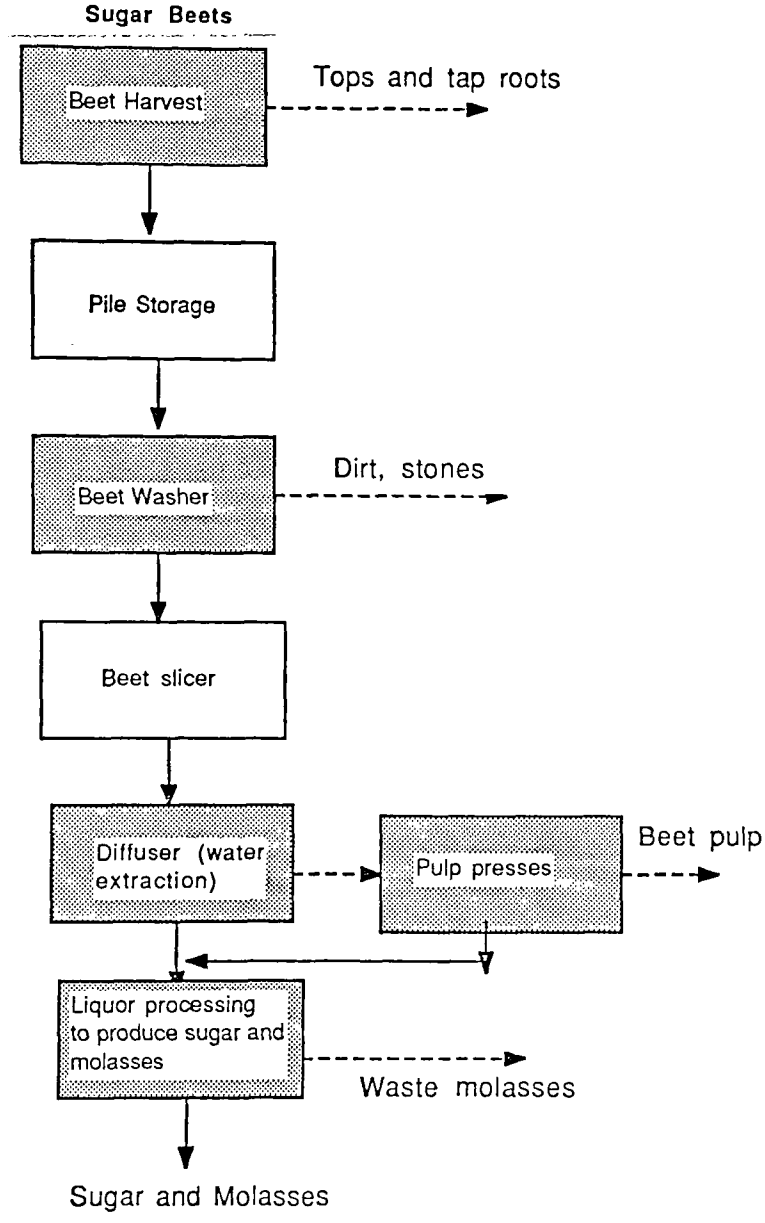


FIGURE A68. RAC Processing Flowsheet for Sugar Beets

COMMODITY: Sugar Cane

PRODUCTS MADE: Raw and refined sugar, molasses

ANIMALS FED: Not specified

PORTIONS FED: Rough molasses

TABLE A69. RAC Utilization Profile for Sugar Cane

	Moisture Content (wt%)				RAC Utilization (see note a)			
Disposition	Min	Max	Mean	σ	Weight	Min	Max	Mean
RAC	14.0	74.5	57.8	25.3	15,418,348	42	14,527,000	3,854,587
Food Product	14.0	74.5	57.8	25.3	1,026,547	6%	13%	7%
Wet Feed	70.0	74.5	72.3	2.3	295,639	0%	4%	2%
Dry Feed	n.r.	n.r.	n.r.	n.r.	0	0%	0%	0%
Land Applied	72.5	72.5	72.5	0.0	16,961	0%	5%	0%
Land Filled	70.0	74.5	72.3	2.3	680,357	0%	100%	4%
Burned	14.0	74.5	57.8	25.3	2,981,806	19%	32%	19%
Other	-		-		115,105	0%	16%	1%
Unaccounted for			-	-	10,301,934			67%

note (a): Values are in wt% of total RAC, except RAC and weight figures, which are in total tons/year.
n.r. indicates that data was not reported by survey respondents.
() around data value indicates a negative mass balance error.

Processing Notes

Cane sugar processors generally produce a raw sugar which is then refined elsewhere. Sugar cane processing is limited to pressing of the raw cane to extract the juice, which is then evaporated and sent elsewhere for refining. The primary byproduct is bagasse (the pressed cane fiber - 50 wt% m.c.) which is used as a fuel, often to provide heat for the evaporation process. Feeding of wastes appears to be limited to integrated operations (ie, those which also refine the sugar). In this case, a waste (sub-food quality) molasses product is produced which can be fed to cattle. The large amount of unaccounted for material reflects moisture losses during processing of the sugar cane.

TABLE A70. Reported Processing Volume (tons/year) for Sugar cane

Total Vol (tons/yr)	Processing Volume in Survey Region (tons RAC/yr)							
	1	2	3	4	5	6	7	9
15,418,348	0	0	0	0	360,915	0	0	15,057,433

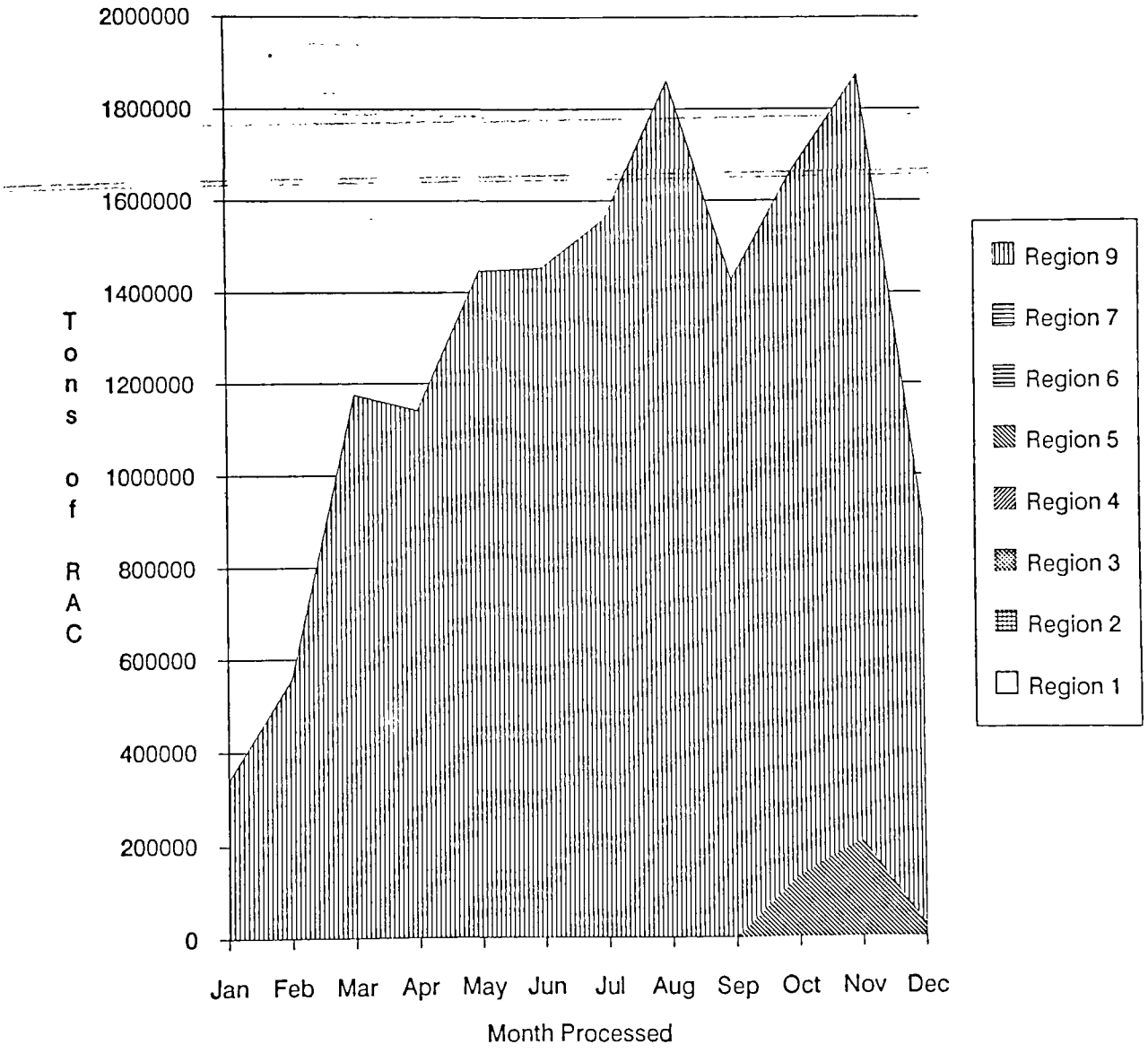


FIGURE A69. Processing Volume (tons/year) - Sugar cane

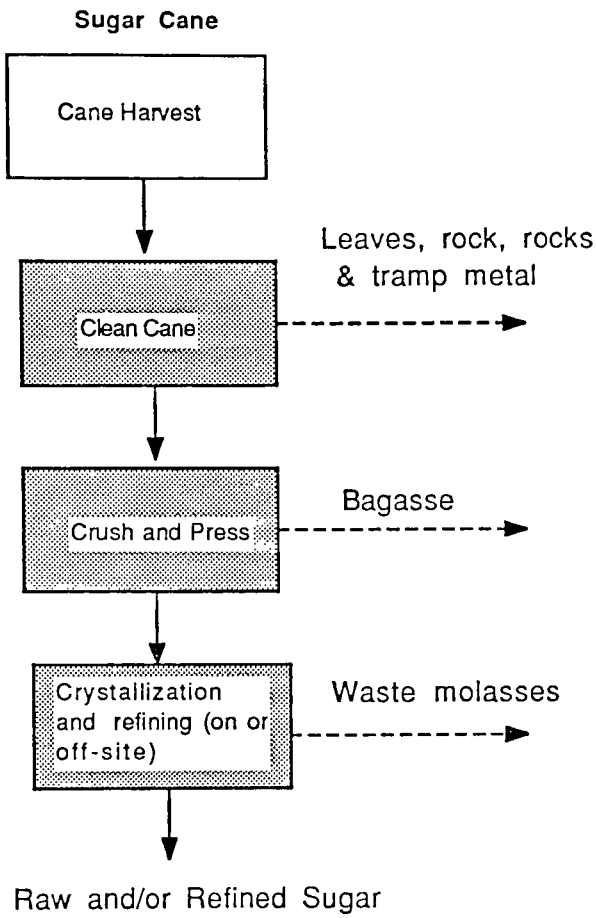


FIGURE A70. RAC Processing Flowsheet for Sugar Cane

COMMODITY: Sweet Corn

PRODUCTS MADE: Canned and frozen corn (on and off the cob); corn starch and sweetener.

ANIMALS FED: Beef and dairy cattle; hogs.

PORTIONS FED: Husks, cobs, some leaves and stalks, silk.

TABLE A71. RAC Utilization Profile for Sweet Corn

	Moisture Content (wt%)				RAC Utilization (see note a)			
Disposition	Min	Max	Mean	- σ -	Weight	Min	Max	Mean
RAC	16.0	80.0	71.1	11.7	3,302,445	4,773	2,340,000	110,081
Food Product	0.0	80.0	67.0	20.2	2,077,404	16%	94%	63%
Wet Feed	0.0	80.0	66.5	20.6	1,163,618	0%	77%	35%
Dry Feed	16.0	16.0	16.0	0.0	0	0%	0%	0%
Land Applied	70.0	80.0	73.0	4.1	23,336	0%	31%	1%
Land Filled	n.r.	n.r.	n.r.	n.r.	1,686	0%	100%	0%
Burned	n.r.	n.r.	n.r.	n.r.	0	0%	0%	0%
Other	-				93,778	0%	29%	3%
Unaccounted for					(57,379)			-2%

note (a): Values are in wt% of total RAC, except RAC and weight figures, which are in total tons/year.
n.r indicates that data was not reported by survey respondents.
() around data value indicates a negative mass balance error.

Processing Notes

Harvested corn is husked, after which the corn kernels may be left on the cob or cut off, depending on the end use. The corn is then blanched, cooled, inspected and sent on to appropriate processing line (ie, either canning or freezing). The principal byproduct is the husk and cob, although unusable whole cobs may also be included in this material. The byproduct (73 wt% m.c.) is fed to cattle and can be ensilaged to improve its feedability.

TABLE A72. Reported Processing Volume (tons/year) for Sweet corn

Total Vol (tons/yr)	Processing Volume in Survey Region (tons RAC/yr)							
	1	2	3	4	5	6	7	9
962,445	Ø	36,421	Ø	660,297	Ø	Ø	265,727	Ø

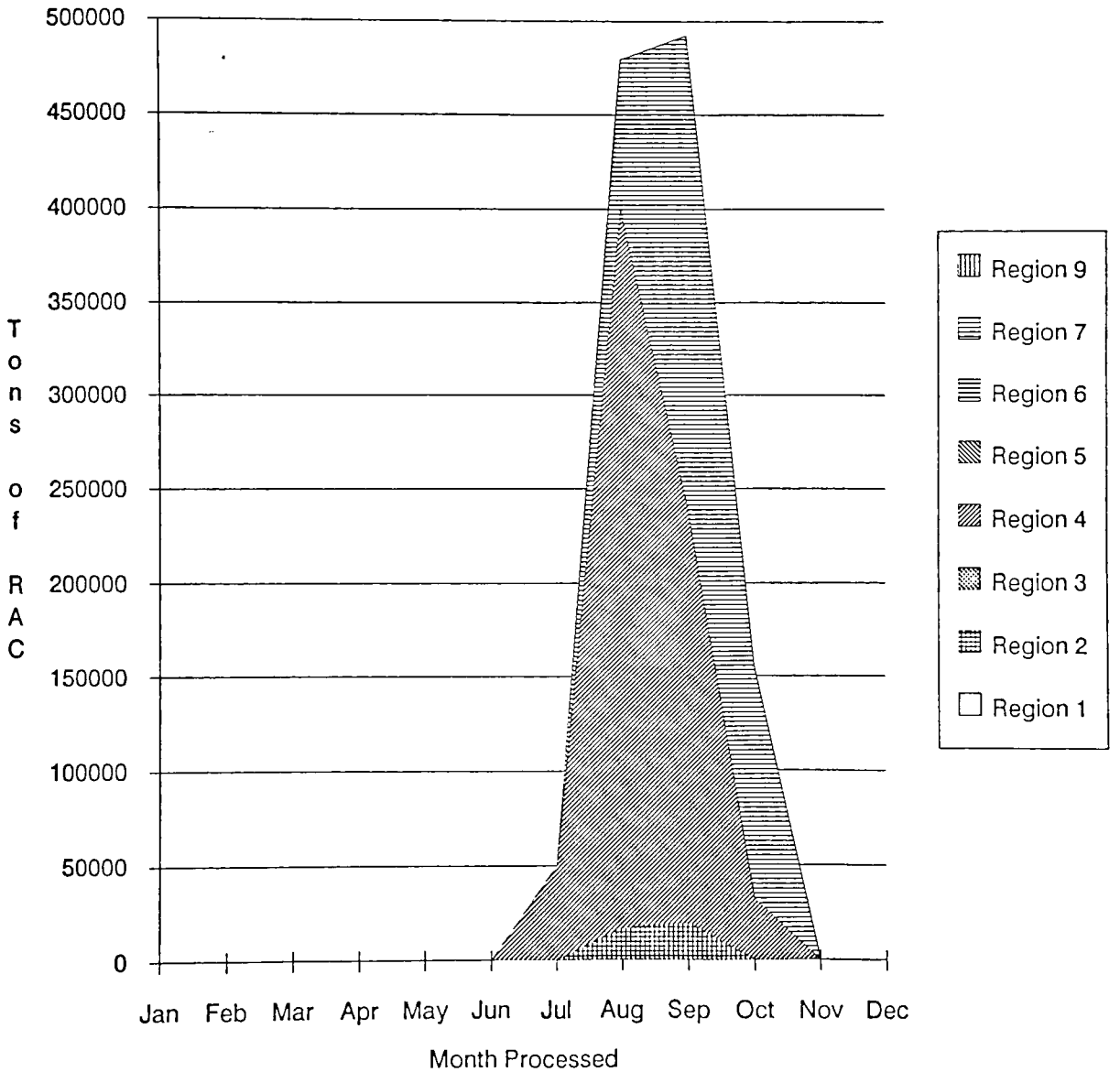


FIGURE A71. Processing Volume (tons/year) - Sweet corn

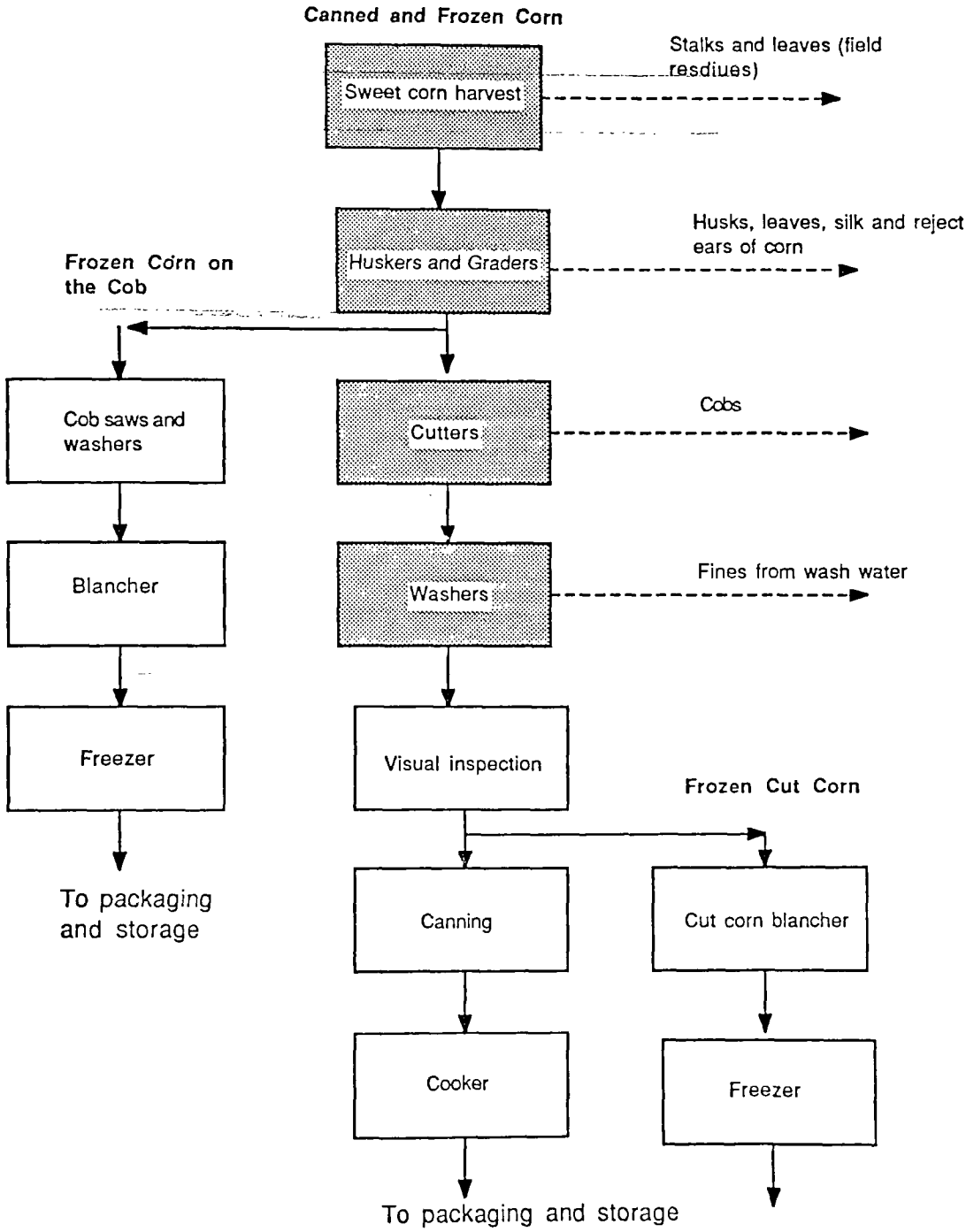


FIGURE A72. RAC Processing Flowsheet for Sweet Corn

COMMODITY: Sweet Potatoes (includes yams).

PRODUCTS MADE: Canned sliced sweet potatoes; frozen yam patties; dehydrated sweet potatoes.

ANIMALS FED: Hogs; Beef cattle; horses.

PORTIONS FED: Ends and defects; peel waste.

TABLE A73. RAC Utilization Profile for Sweet Potatoes

	Moisture Content (wt%)				RAC Utilization (see note a)			
Disposition	Min	Max	Mean	σ	Weight	Min	Max	Mean
RAC	70.0	78.0	73.4	2.7	54,092	300	12,512	6,762
Food Product	73.0	78.0	75.0	2.2	33,781	44%	95%	62%
Wet Feed	74.0	78.0	76.0	2.0	10,612	0%	50%	20%
Dry Feed	n.r.	n.r.	n.r	n.r.	0	0%	0%	0%
Land Applied	73.0	78.0	75.0	2.2	8,434	0%	50%	16%
Land Filled	73.0	73.0	73.0	0.0	1,175	0%	100%	2%
Burned	n.r.	n.r.	n.r.	n.r.	15	0%	5%	0%
Other					0	0%	0%	0%
Unaccounted for					75			0%

note (a): Values are in wt% of total RAC, except RAC and weight figures, which are in total tons/year
n.r. indicates that data was not reported by survey respondents.
() around data value indicates a negative mass balance error.

Processing Notes

Sweet potatoes are washed to remove soil and stones prior to preheating and steam peeling. The steam peeling step is followed by a scrubbing step to remove eyes. The potatoes are then mechanically size-sorted and may be visually inspected prior to canning (especially for small potatoes which are canned whole). Wastes are derived primarily from the steam peeling step and inspection; some wastes are produced in the slicing operations.

TABLE A74. Reported Processing Volume (tons/year) for Sweet potatoes

Total Vol (tons/yr)	Processing Volume in Survey Region (tons RAC/yr)							
	1	2	3	4	5	6	7	9
54,092	0	0	5,500	0	46,642	0	0	1,950

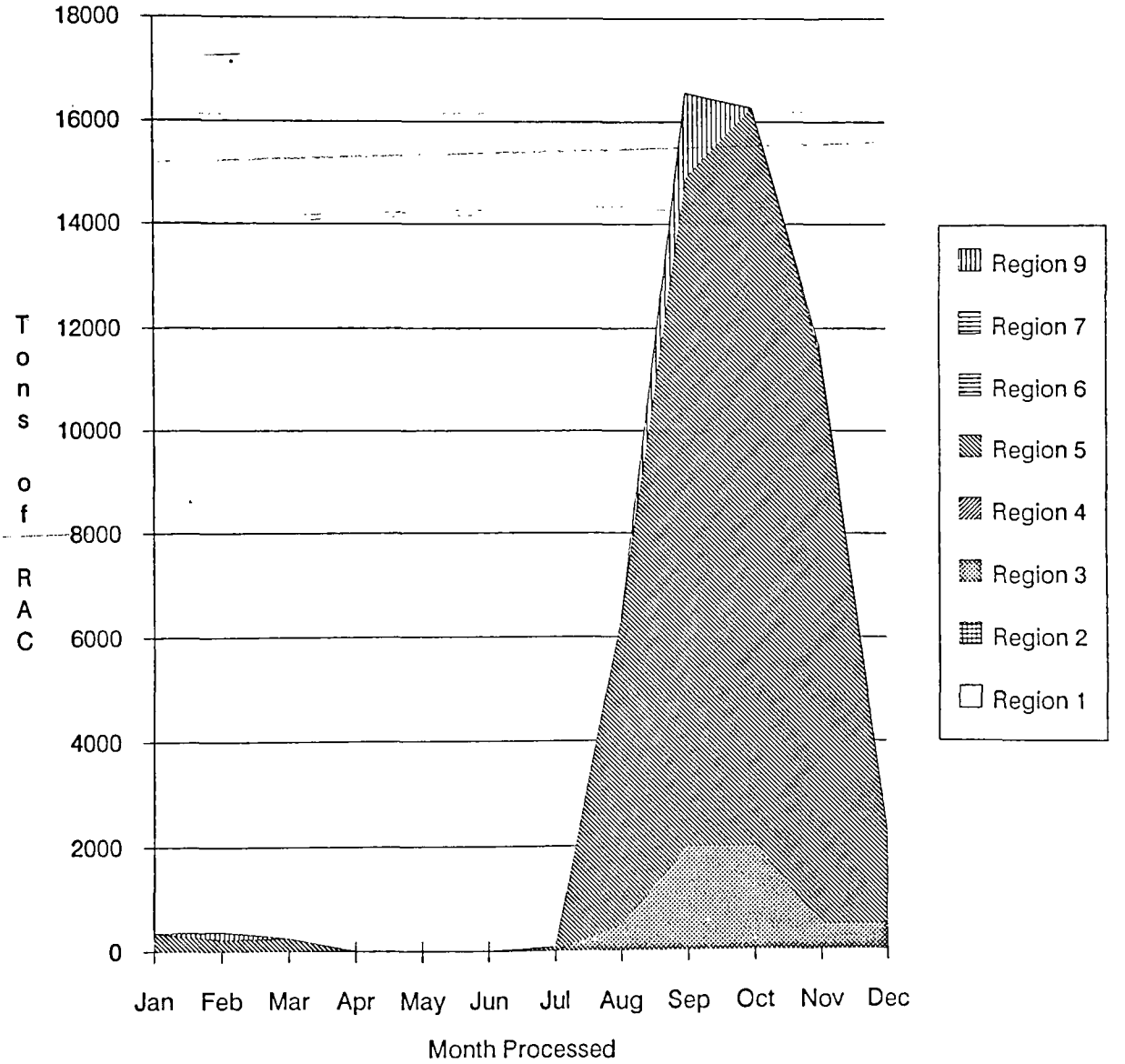


FIGURE A73. Processing Volume (tons/year) - Sweet potatoes

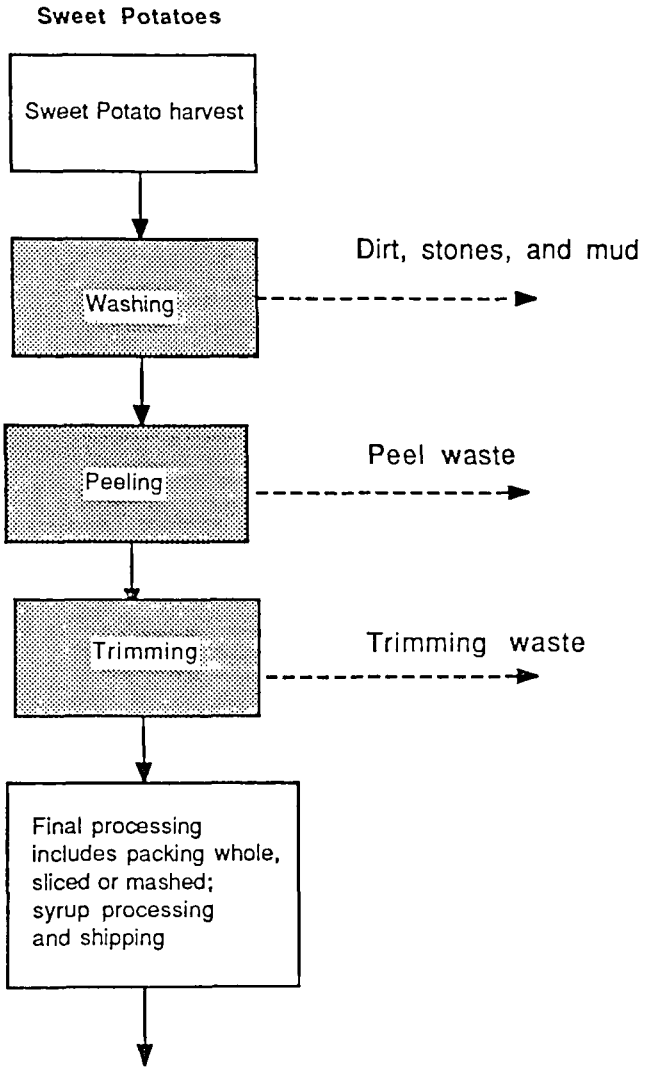


FIGURE A74. RAC Processing Flowsheet for Sweet Potatoes

COMMODITY: Table beets (red beets).

PRODUCTS MADE: Canned whole/sliced beets; pickled beets.

ANIMALS FED: Cattle (only beef cattle were specified) and hogs; sheep.

PORTIONS FED: Peel waste, culls, crowns, taproots and screened solids from downstream cooking operations. Aggregate feed waste had a mean m.c. of 79.2 wt%

TABLE A75. RAC Utilization Profile for Table (red) Beets

	Moisture Content (wt%)				RAC Utilization (see note a)			
Disposition	Min	Max	Mean	σ	Weight	Min	Max	Mean
RAC	50.0	87.6	81.3	12.1	97,183	460	20,888	8,835
Food Product	50.0	87.0	79.3	13.3	46,207	30%	75%	48%
Wet Feed	50.0	87.0	79.2	14.6	22,346	0%	47%	23%
Dry Feed	n.r.	n.r.	n.r.	n.r.	0	0%	0%	0%
Land Applied	50.0	87.0	68.5	18.5	22,698	0%	50%	23%
Land Filled	n.r.	n.r.	n.r.	n.r.	115	0%	100%	0%
Burned	n.r.	n.r.	n.r.	n.r.	0	0%	0%	0%
Other					5,741	0%	27%	6%
Unaccounted for	-				76			0%

note (a): Values are in wt% of total RAC, except RAC and weight figures, which are in total tons/year.
n.r. indicates that data was not reported by survey respondents.
() around data value indicates a negative mass balance error.

Processing Notes

Beets are washed to remove stones and dirt prior to peeling. Caustic and mechanical peeling methods are used. The peeled beets are hand inspected and the culls are combined with peel waste prior to being fed to cattle. Minor waste contributions come from cooking/spillage and other canning-related sources.

TABLE A76. Reported Processing Volume (tons/year) for Table beets

Total Vol (tons/yr)	Processing Volume in Survey Region (tons RAC/yr)							
	1	2	3	4	5	6	7	9
97,183	9,000	18,846	0	37,189	11,260	0	20,888	0

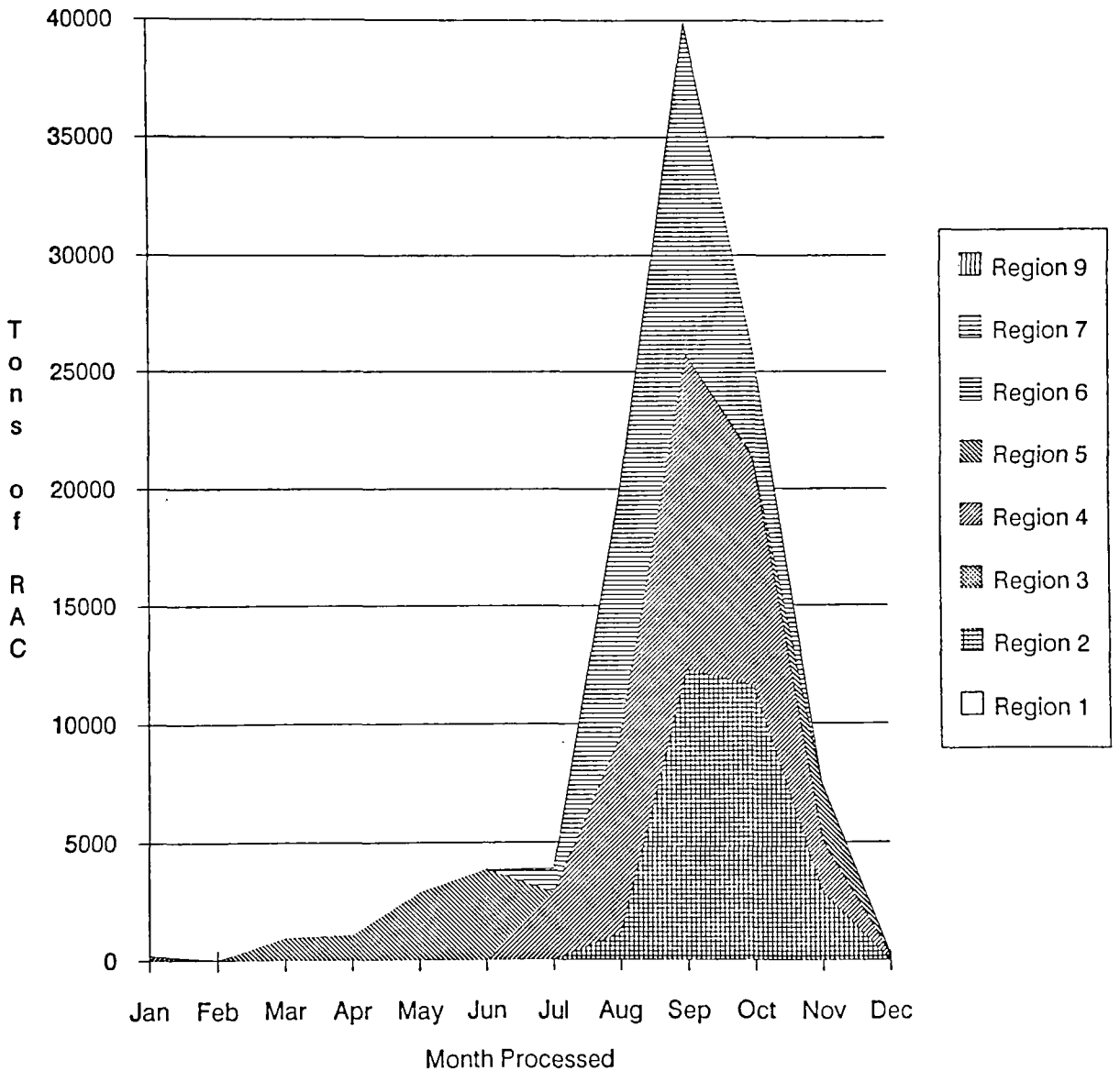


FIGURE A75. Processing Volume (tons/year) - Table beets

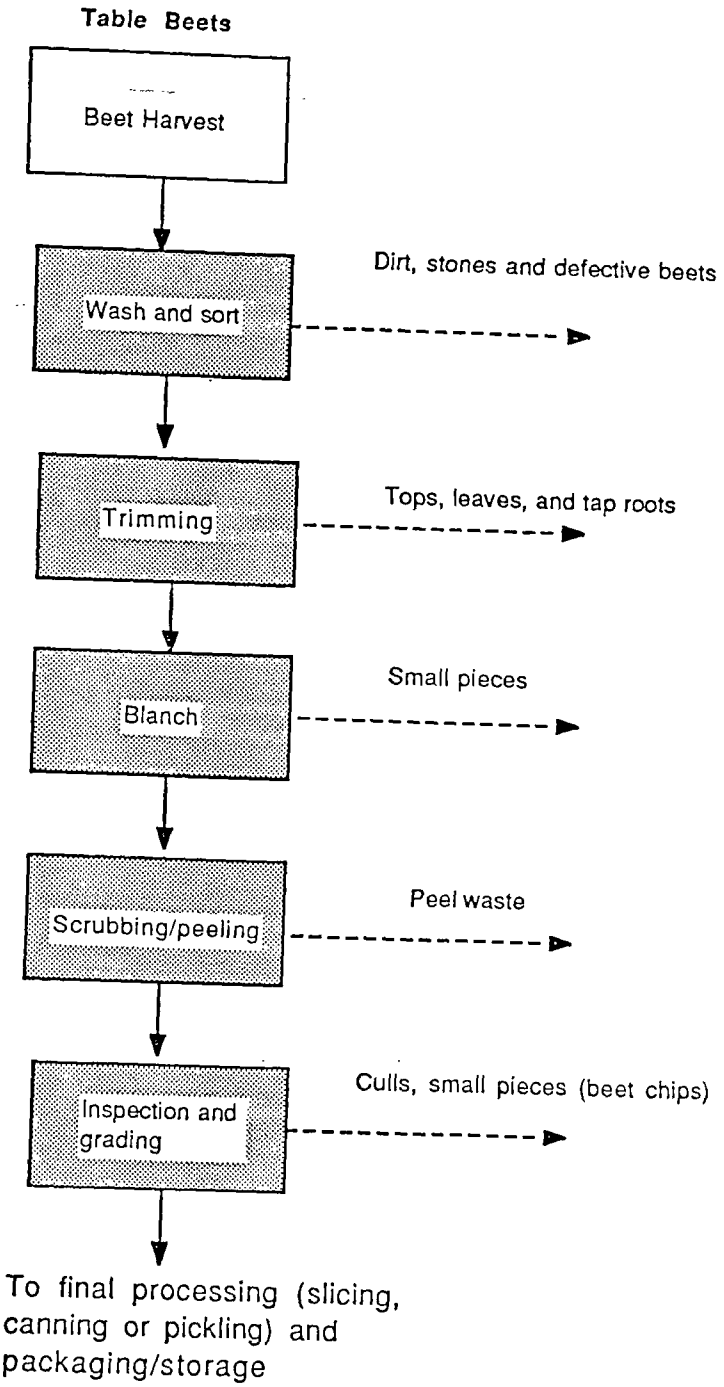


FIGURE A76. RAC Processing Flowsheet for Table (red) Beets

COMMODITY: Tomatoes (includes tomatillos and green tomatoes)

PRODUCTS MADE: Catsup, puree, paste, juice, sauces and canned tomatoes.

ANIMALS FED: Primarily cattle; hogs.

PORTIONS FED: Pomace, seeds, skins, culls and loose pieces.

TABLE A77. RAC Utilization Profile for Tomatoes

	Moisture Content (wt%)				RAC Utilization (see note a)			
Disposition	Min	Max	Mean	σ	Weight	Min	Max	Mean
RAC	68.0	96.0	91.0	6.8	2,775,664	359	354,870	120,681
Food Product	68.0	96.0	89.7	8.2	2,333,418	17%	99%	84%
Wet Feed	90.0	95.4	93.8	1.8	72,806	0%	12%	3%
Dry Feed	94.0	95.0	94.5	0.4	13,715	0%	2%	0%
Land Applied	85.0	96.0	93.0	4.0	46,819	0%	31%	2%
Land Filled	68.0	94.0	83.6	9.0	13,630	0%	100%	0%
Burned	n.r.	n.r.	n.r.	n.r.	0	0%	0%	0%
Other	-			-	311,438	0%	82%	11%
Unaccounted for	-				(16,162)	-		-1%

note (a): Values are in wt% of total RAC, except RAC and weight figures, which are in total tons/year.
n.r. indicates that data was not reported by survey respondents.
() around data value indicates a negative mass balance error.

Processing Notes

Ripe tomatoes are soaked and washed to remove dirt, then scalded to facilitate the removal of the skins. Canned tomatoes may then be filled and exhausted. Tomatoes processed to produce paste or catsup are also pulped and screened to remove seeds, and the resultant juice is evaporated to the desired solids concentration.

TABLE A78. Reported Processing Volume (tons/year) for Tomatoes

Total Vol (tons/yr)	Processing Volume in Survey Region (tons RAC/yr)							
	1	2	3	4	5	6	7	9
2,775,664	0	20,000	5,000	89,806	1,608	3,000	0	2,656,250

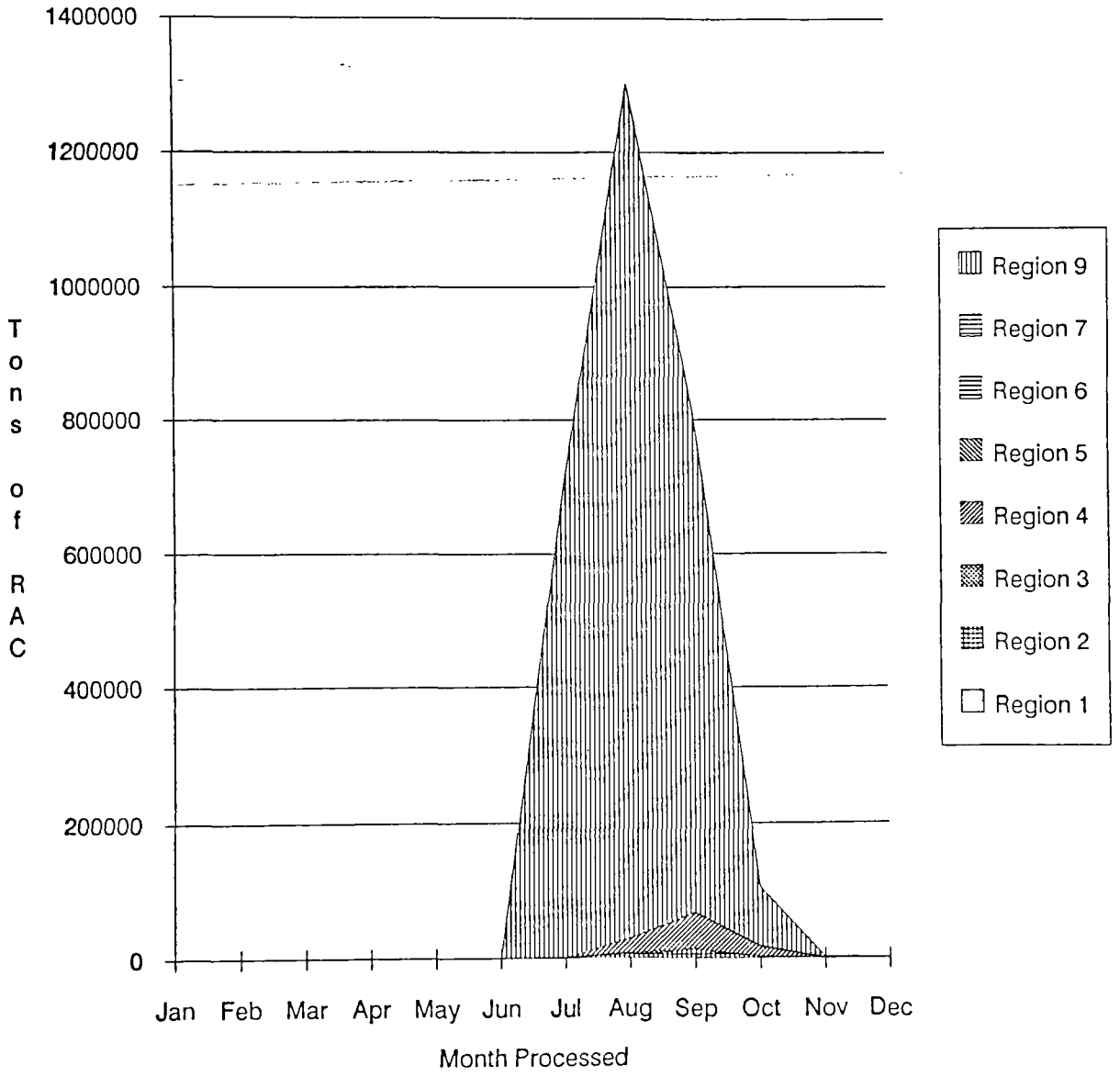


FIGURE A77. Processing Volume (tons/year) - Tomatoes

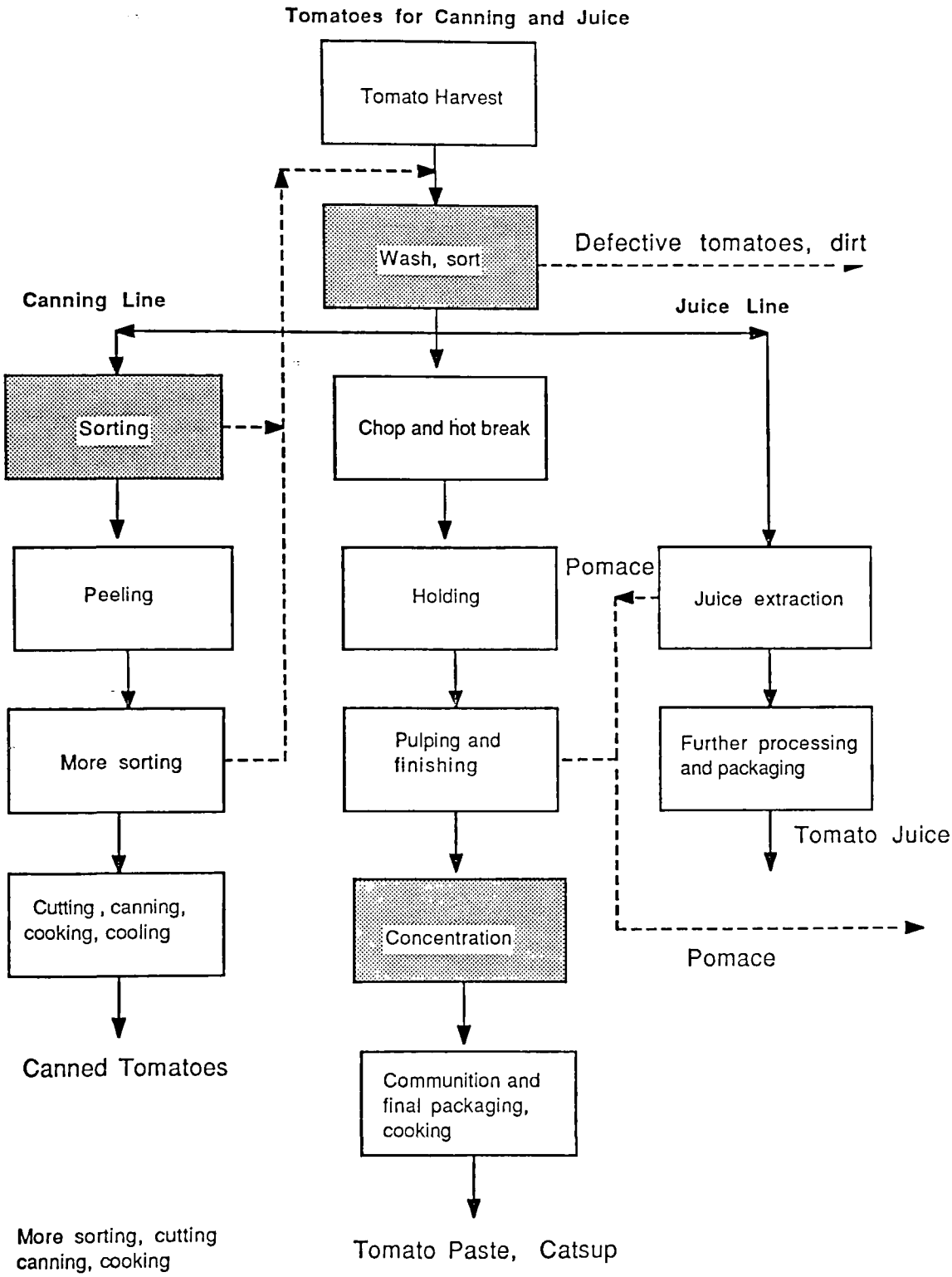


FIGURE A78. RAC Processing Flowsheet for Tomatoes

COMMODITY: Wheat

PRODUCTS MADE: Flour, bran, germ and starch

ANIMALS FED: Cattle, hogs

PORTIONS FED: Midds, bran, germ and fiber

TABLE A79. RAC Utilization Profile for Wheat

	Moisture Content (wt%)				RAC Utilization (see note a)			
Disposition	Min	Max	Mean	σ	Weight	Min	Max	Mean
RAC	11.3	12.7	12.1	0.5	1,800,247	67,569	441,360	257,178
Food Product	11.3	12.7	12.1	0.5	1,335,907	37%	95%	74%
Wet Feed	12.5	12.5	12.5	0.0	0	0%	0%	0%
Dry Feed	11.3	12.7	12.1	0.5	429,954	5%	27%	24%
Land Applied	n.r.	n.r	n.r.	n.r.	0	0%	0%	0%
Land Filled	12.0	12.0	12.0	0.0	1,947	0%	100%	0%
Burned	n.r.	n.r.	n.r.	n.r.	0	0%	0%	0%
Other	-				15,576	0%	16%	1%
Unaccounted for	-	-		-	16,864			1%

note (a): Values are in wt% of total RAC, except RAC and weight figures, which are in total tons/year.
n.r. indicates that data was not reported by survey respondents.
() around data value indicates a negative mass balance error.

Processing Notes

Stored wheat is cleaned (by air scalping or aspiration) to remove dirt, stones, wheat hairs and loose bran. The cleaned wheat is tempered and milled between rollers. The milled wheat can then be separated into the various fractions (germ, bran, etc) which can either be used as food or feed products.

TABLE A80. Reported Processing Volume (tons/year) for Wheat

Total Vol (tons/yr)	Processing Volume in Survey Region (tons RAC/yr)							
	1	2	3	4	5	6	7	9
1,800,247	0	807,253	0	992,994	0	0	0	0

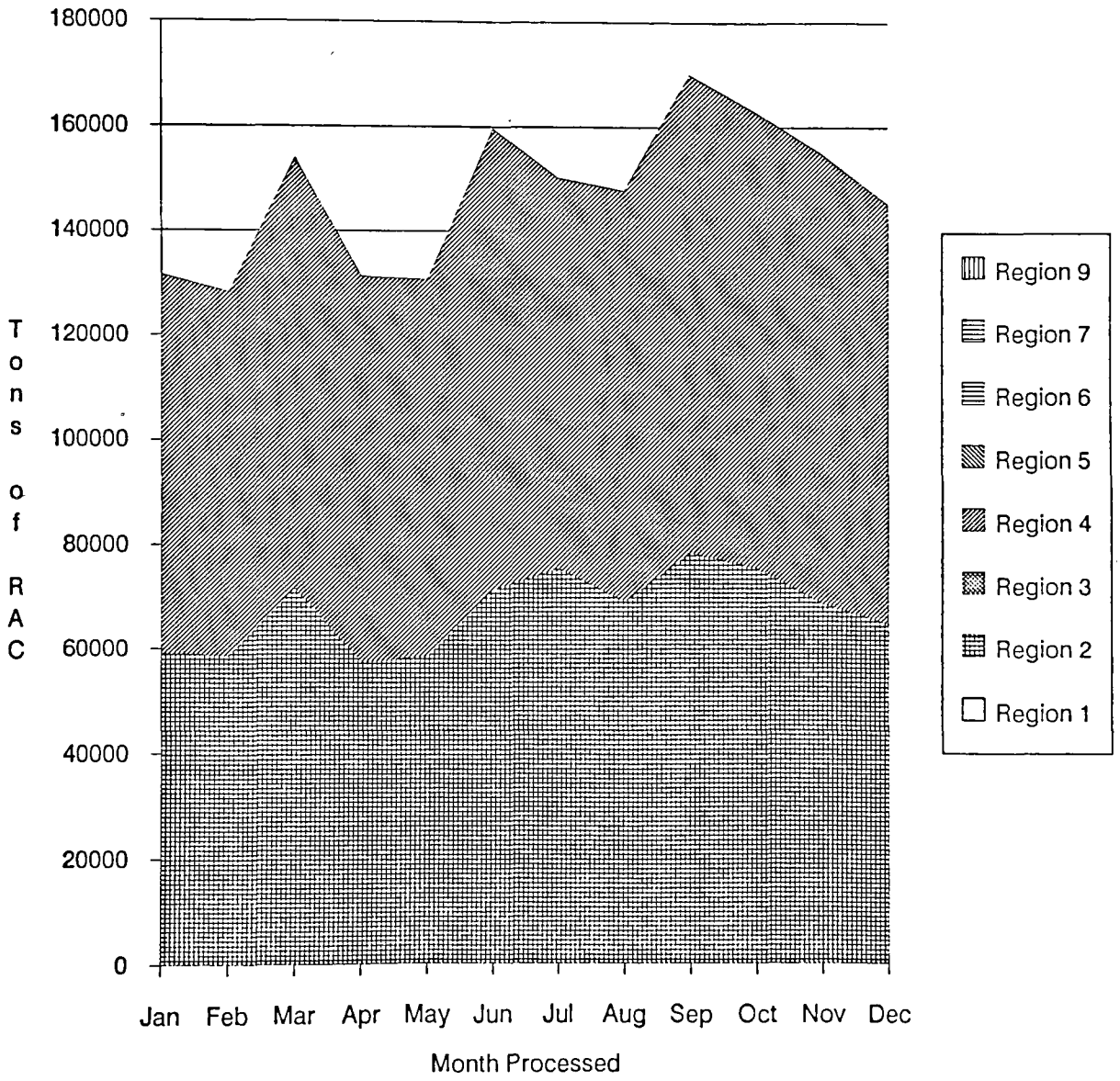


FIGURE A79. Processing Volume (tons/year) - Wheat

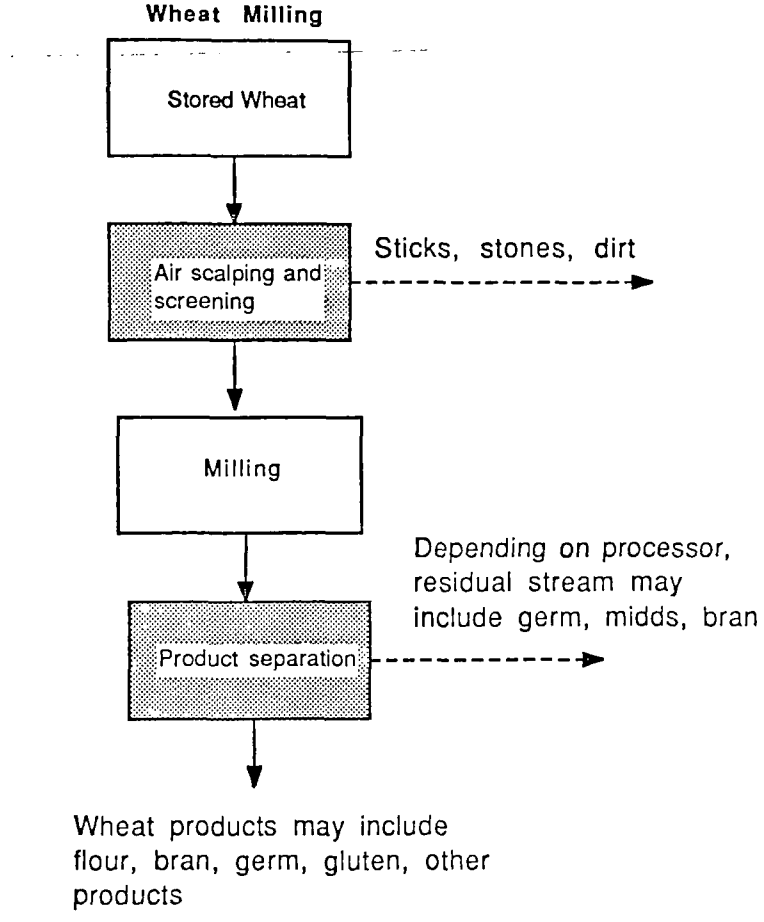


FIGURE A80. RAC Processing Flowsheet for Wheat

APPENDIX B. GLOSSARY OF FOOD PROCESSING TERMINOLOGY

APPENDIX B. GLOSSARY OF FOOD PROCESSING TERMINOLOGY

Air Scalping	A cleaning operation which uses high-velocity air streams to remove foreign material from a dry RAC. The process requires a difference in size, density, or shape between the RAC and the foreign material, and is used to separate dirt and stones from dry beans, shelled corn, and other grains. It is also used to remove leaves and twigs from some RACs.
Aspirated	A method of removing fiber from milled grains. It is similar to air scalping, in that it relies on size and density differences between the intermediate product and the waste.
Bagasse	Extracted sugar cane fiber. It is generally used for fuel, although it may also be used to produce structural materials (bagasse board).
Beetchips	Waste material from the processing of sugar beets.
Blanching	Heat treatment of vegetables prior to canning. Blanching is done using either hot water or live steam, and helps to stabilize the product with regard to flavor and volume. Blanching processes may produce a wet solids waste of insoluble solids removed during the step.
Byproduct	A useful product derived from RAC processing, but not the primary food product which is produced from the RAC. Examples of byproducts include cattle feed, citrus peel, almond hulls, and cottonseed linters. Effective byproduct utilization is critical to the food processing industry.
CA Storage	Controlled Atmosphere storage. A preservation technique which involves storing a RAC under an inert atmosphere (generally either carbon dioxide or nitrogen) to permit extended storage prior to final processing. CA storage has been used to extend the processing season of certain RACs (for example, apples).
Culls	RAC which has been removed from the processing line due to some deficiency - ie., immature, damaged, or otherwise unusable. Culls are often fed to livestock.
Ensilage	The process of making silage. Silage is vegetative material which is stored for long-term feeding to livestock and undergoes partial fermentation during storage. This increases the digestibility of the material.

Fiber	In a food processing context, fiber is the structural portion of the processed plant material. It may be left in the food product (as in vegetable processing) or removed (as in sugar cane processing). Many food processing byproducts are fibrous materials.
Florets	As in the term "discolored florets." Individual sections of plants such as broccoli and cauliflower. Discoloration is an indicator of overripeness and deteriorated quality. Discolored florets are generally trimmed by hand and treated as waste.
IQF	Individually Quick Frozen. A method of rapidly freezing RACs for sale as a frozen product. Quick freezing improves product quality and appearance relative to older freezing techniques.
Linters	Cotton fibers which are removed from cottonseeds prior to processing for oil extraction. They are often removed in more than one step, leading to the terms "first-cut linters," "second-cut linters," and so on. They are often used as a source of non-dietary fiber.
m.c.	Moisture content. In this report, moisture content is always expressed on a wet basis - that is, the percentage of a RAC's initial weight which is lost during drying to constant weight under controlled conditions of temperature and humidity.
Midds	A byproduct from grain milling (particularly wheat flour) processes which comprises bran and germ removed from the milled grain by screening and/or aspiration.
Pearlers	Equipment used in the milling and finishing of white rice. Pearlers are used to remove the outer material from the rice grain and impart a polished, clean surface to the rice.
Pomace	Skins, seeds, and fiber which remain after the pressing of fruit to produce juice. Common types of pomace include apple, grape, and tomato. Pomace may be fed to livestock, fermented to make vinegar, or disposed of as waste.
RAC	Raw agricultural commodity. Fruit, grain, produce or other agricultural crop in its raw, unprocessed state.
Residue	Chemical compounds derived from pesticides or other agricultural chemicals, which remain on RACs following harvest.

SIC	Standard Industrial Code. Classification system used to categorize industries by the type of product or services they provide.
Snipper Waste	A waste generated in the processing of certain RACs such as green peas and green beans. The waste comprises portions of the RAC which are too tough or fibrous to eat, and usually comes from the flower end of the pod.
Spent Grain	(Also Spent Brewer's Grain, Spent Distiller's Grain) Solid byproducts remaining after crushed or rolled grain (barley, rice, corn, oats, etc) is extracted to remove soluble sugars and flavor agents. The extracted material is fermented and further processed to produce beer, liquor, etc., while the spent grains are pressed to remove free water, and are used as a livestock feed. Processors may dry the grain prior to selling as a feed material, especially if the feed markets are relatively distant.

DATABASE INTEGRITY PLAN (DIP) FOR THE FOOD PROCESSING SOLID WASTE CHARACTERIZATION SURVEY (FPWC)

REVISION 1.0

Prepared by Battelle-Northwest Laboratories
Richland, Washington 99352

DATABASE INTEGRITY PLAN (DIP) FOR THE FOOD PROCESSING SOLID WASTE CHARACTERIZATION SURVEY (FPWC)

This report documents the methods and procedures which will be used to insure the integrity and accuracy of data compiled from the Food Processing Solid Waste Characterization Survey (FPWC). The survey was prepared by the National Food Processor's Association (NFPA) and Battelle-Northwest (BNW), and requests information concerning the fate, amount, and type of solid wastes produced in the food processing industry. The data will be used by the Environmental Protection Agency (EPA) in determining the need for the establishment of maximum allowable tolerance levels for pesticide residues which may be present on solid wastes produced by the food processing industry. The data will be collated and analyzed by BNW under a sub-contractual agreement with the NFPA.

This document comprises the quality assurance plan called for in Task 3b, and will henceforth be known as the Database Integrity Plan (DIP), or simply the Plan. The Plan is provided to insure that adequate forethought has been given to the methods and procedures used in the various stages of the project. Specifically, the DIP addresses the following:

1. design and validation of the database;
2. standard procedures for data entry and follow-up;
3. procedures for protecting data in the database.

Source of Data - The Food Processing Solid Waste Characterization Survey

The survey will be mailed to approximately 3000 food processing plants throughout the United States. These plants will include representatives of processors in selected food processing industries. Table 1 lists the Standard Industrial Code (SIC) categories which have been included in the study.

Information requested on the survey (which is attached as Exhibit 1) includes plant location, raw agricultural products (RAC's) processed, and source, quantity and waste disposition data for each of the RAC's. A process flowsheet is also being requested from each survey respondent. The flowsheet will permit further characterization of the waste streams produced in these plants.

The information collected on the survey will be entered manually into a personal computer (PC) based database produced specifically for the purpose of organizing, collating, and analyzing the data. The collated data will then be incorporated into a final report as called for in Task 5 of the Statement of Work, and will provide breakdown by raw agricultural commodity (RAC), source of RAC, quantity of RAC processed (by month/season) and parts

used or produced from each RAC. The tabularized data will provide detailed information for each part used or product produced (including waste byproducts) including average moisture content, annual total output, percent of RAC processed, and fate. Fate will include major categories such as human or animal consumption, burial, incineration, land application, etc. If possible, the type of animal fed will also be included. This final report will be used by the EPA in determining the need for FAT's on a commodity by commodity basis.

TABLE 1. List of Standard Industrial Commodity Codes Included in the Survey

SIC number	description
2032-2035, 2037-2038	canned specialties; canned and dehydrated fruits frozen fruits, fruit juices and vegetables
2041	flour and other grain mill products
2043	cereal breakfast foods
2044	rice milling
2046	wet corn milling
2061	cane sugar (except refining)
2063	beet sugar
2065	candy and other confectionery products
2066	chocolate and cocoa products
2074-2076	vegetable and seed oils
2079	shortening, table oils, margarine, etc
2082-2085	malt beverages, wines and liquors
2087	flavor extracts
2095	roasted coffee
2099	others (potato chips, tea, spice preparation, etc)
4221	dried beans

DESIGN AND VALIDATION OF THE DATABASE

The Food Processing Solid Waste Characterization Survey (FPWC) is a multi-page document which will contain a large amount of information when it is completed. In order to utilize this information, a computerized database will be employed to organize the data and facilitate retrieval of individual responses (also known as database "records") based upon user-provided criteria. A commercial database program (dBASE III Plus, published by Ashton-Tate) will be used to create the structure for the database. Data for analysis will be selected from the database using the program's built in query features, and selected records will be exported from the database in ASCII format and analyzed using commercially available statistical packages. A number of statistical software packages are being considered for use.

Due to the complexity of the survey forms, the structure of the database has been designed to incorporate three separate database files which are related via shared data fields. The database has been designed to allow linking of records in one file with records in the other files via use of a common field which is shared between them (this is known as a "relational" database). The database structure is shown schematically in Figure 1. Note that the database does not conform exactly to the physical layout of the survey form; this is due to differences in data representation between the survey form and the database. All information contained on the survey forms (parts II and III) will be available in the database.

Sorting and record recovery is generally performed by using pre-selected fields, which are often called "keys". In Figure 1, the key fields have been listed in bold type. These represent the fields which will most commonly be used as criteria for sorting and selecting records.

Validation of the data extracted for analysis and tabulation will be performed by random manual checks of the data against the written and original database entries. Extensive validation will occur during the first several queries made using the completed database. Subsequent checks will be performed to select approximately 10% of the data records which are extracted from the database.

Adequacy of the Survey Form and Distribution Plans

The primary responsibility for the development of the survey form lies with the NFPA. The adequacy of the survey form was insured by subjecting it to review by professional staff at Battelle Northwest, NFPA, and the EPA. Draft copies were sent to selected industry contacts for evaluation. Comments and suggestions made by these reviewers have been incorporated into the revised form. The form was also been subject to approval by both the EPA and the Office of Management and Budget (OMB).

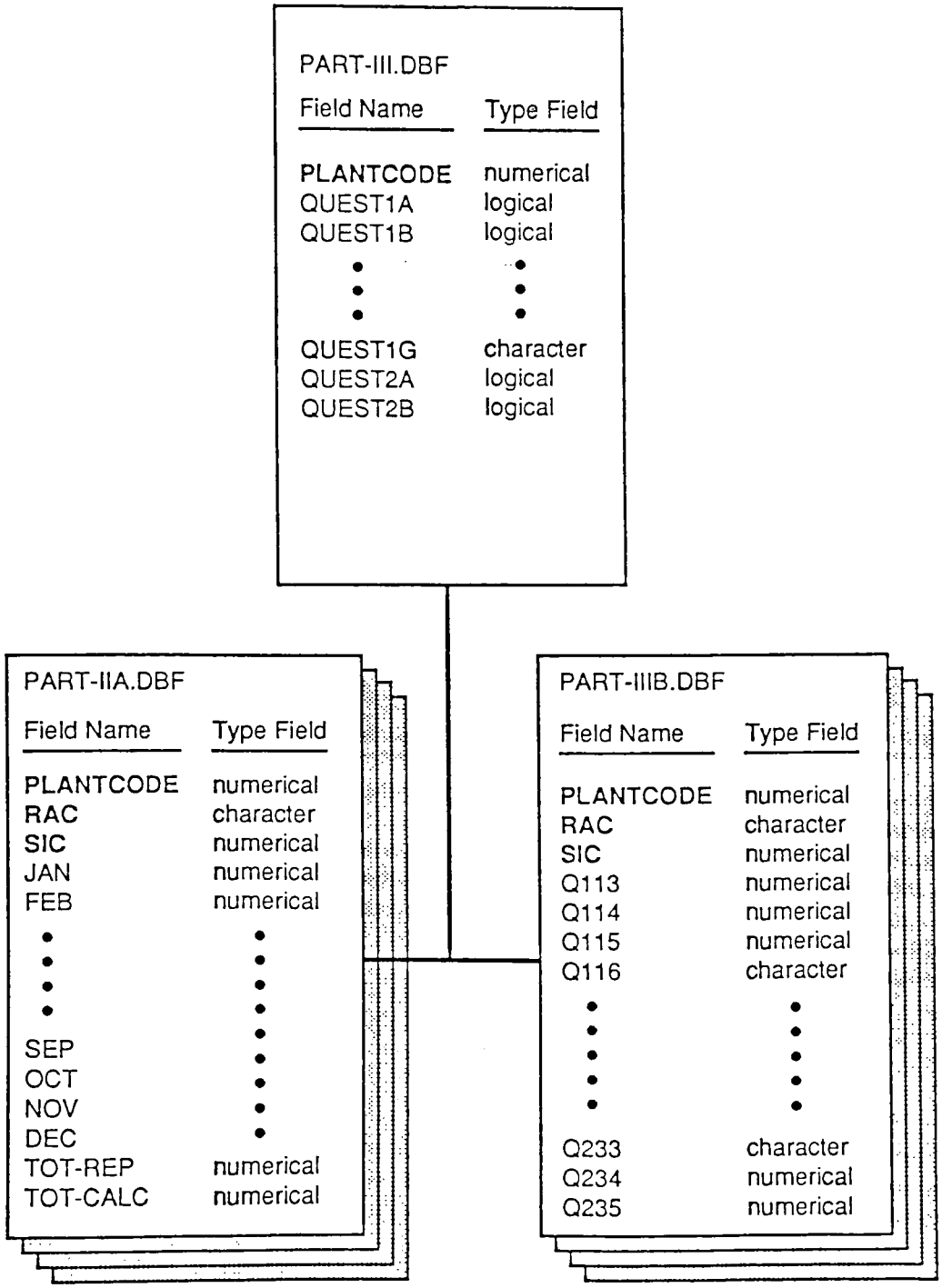


FIGURE 1. Schematic Representation of the FPWC Database

The survey will be mailed to approximately 3000 food processing plants in the United States, which were selected from an estimated 6145 plants which process foods in the targeted SIC categories. Sampling protocol, including sample selection, follow-up strategy, and sample stratification, will be based upon sound statistical practices and will be in accordance with procedures developed by Battelle-Northwest and agreed to by NFPA and the EPA. An analysis of the sample distribution and response rate will be included in the final report. The mailing list represents a substantial fraction of those plants believed to be processing RAC's.

PROCEDURES

Protection of Confidential Data Contained in Survey Responses.

The data which is contained on the completed survey responses will include specific plant operating characteristics. Unauthorized release of this information could potentially damage the competitive position of survey respondents. Therefore, it is important to take steps to maintain the confidential nature of the survey responses.

For the sake of this project, confidentiality will be maintained by limiting access to the raw data (ie, survey responses) and by processing the RAC information separately from the plant information. The combination of these safeguards will prevent the purposeful or accidental release of information about specific plant operating characteristics.

The processing of completed surveys will be handled in a multi-step process, illustrated schematically in Figure 2. In the first step, the completed survey responses will be sent to NFPA. NFPA staff will log the survey form into its records, assign each survey a unique plant code identification number, and detach the first page (Part I on the attached Exhibit 1). The plant code identification number will be written, along with a geographic region code (assigned using standard EPA regions), in the upper right hand corner of the survey response sheets (see Parts II and III of Exhibit 1). The coded survey responses will then be sent to BNW for entry into the main database and subsequent analysis. All survey responses will be kept in locked file cabinets when not actually in use. Battelle-Northwest's role as a Department of Energy laboratory (operating as Pacific Northwest Laboratory) further insures a high level of security, since general public access to all BNW facilities is severely restricted. Parts I and II of the survey form are considered Confidential Business Information (CBI) and will be destroyed by NFPA subsequent to the approval of the final report by EPA.

The use of a unique plant identification number will permit individual responses to be identified for follow-up calls if data testing indicates that such follow-up is required (see following sections).

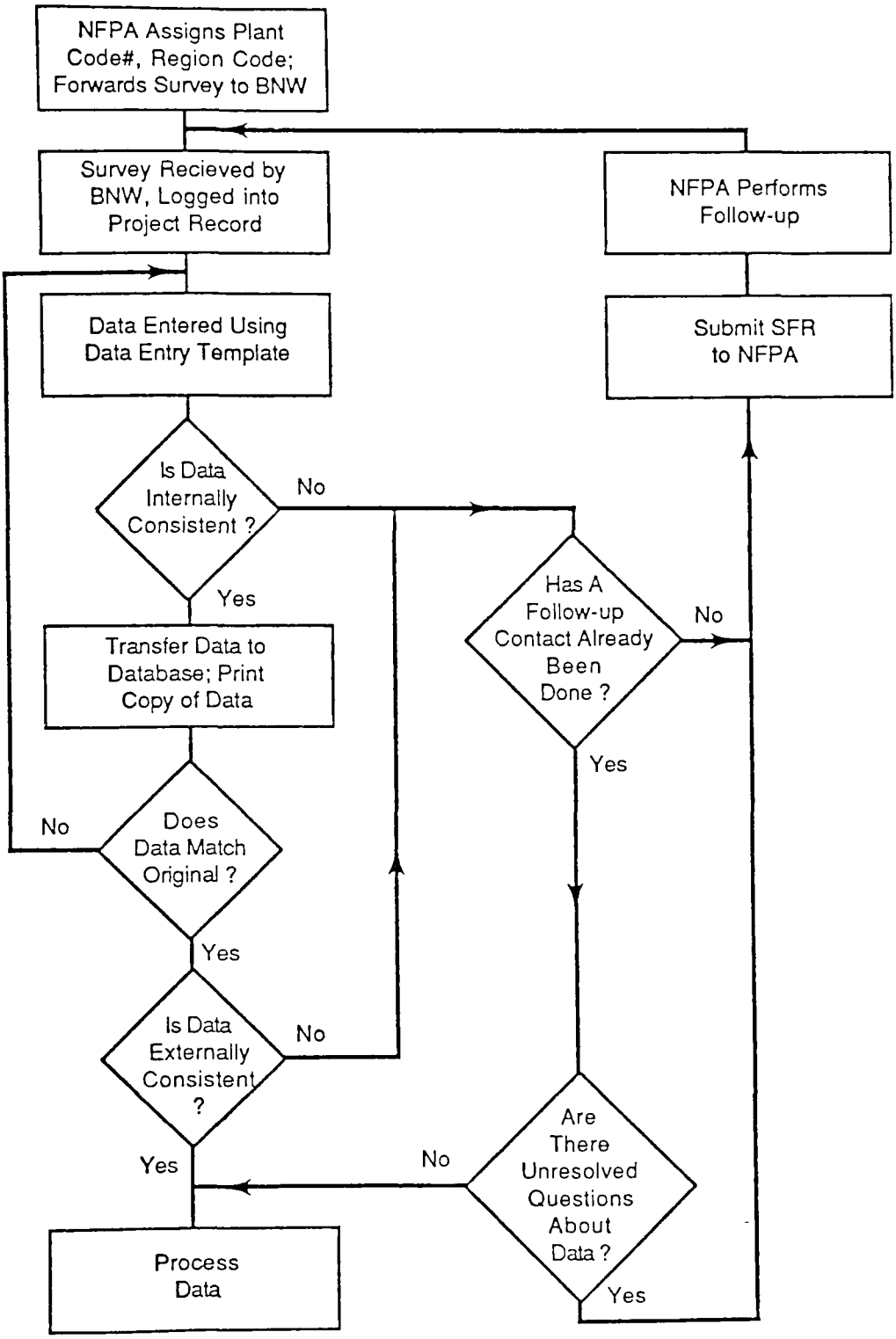


FIGURE 2. Information Flow Diagram for FPWC Survey

Insuring the Accuracy of Survey Responses

Any plan to insure the quality of the data collected from survey responses must include some procedures to check the quality of the original data. Errors in the survey responses may be due to poor plant records, failure to follow survey directions, or errors in filling out the survey. Procedures developed to check for these errors must be "passive" in the sense that they do not require that BNW or NFPA staff have direct access to plant records. Two primary approaches will be employed which meet this criteria; external consistency checks and internal consistency checks.

The check for external consistency is comprised of a series of simple statistical tests. The tests rely on the assumption that similar operating conditions often evolve out of efforts to optimize the plant configuration for a given RAC/product combination. Based on this assumption, "outlier" records within a group of similar plants will be "flagged". These flagged responses will then be checked for accuracy by verifying the survey responses with the plant contact. This follow-up contact will be made by the NFPA.

As an example of an external consistency check, we can compare the solids content of all wastes described as "grape pomace" or "grape pressings". Since the solids content of grape pomace (pressings from the manufacture of grape juice and wine) does not generally vary much beyond the typical range of 35-55 wt%, the database could be searched for records which report significantly higher or lower solids content. These records would be flagged for verification of the data, first by comparing the data in the database to the original survey form, then by the use of follow-up contacts with the survey respondent. NFPA will conduct the follow-up surveys using a combination of written and telephone communications, and/or site visits. The procedures for conducting these follow-up contacts are described in the following section. These contacts would establish whether the reported data was in error, or a result of some unique configuration of the processing plant.

In actual practice, of course, tabulated values of these parameters may not exist. In lieu of this data, means and standard deviations will be determined from the survey population itself. Data outliers within each sub-population can then be identified. Several data fields may be employed to perform this screening of data, as will derived values obtained from manipulation of survey data. Table 2 illustrates the parameters which will be used as initial criteria for flagging records. Others may be added as required, or if examination of the survey responses indicates that other parameters would be useful as screening criteria.

Survey responses can also be checked for internal consistency. For example, a material balance around the plant can be determined by comparing the commodity inputs with the product and waste output. An initial tolerance of ±5% will be used, although this tolerance may be adjusted at a later point depending upon the accuracy of the completed surveys. The tolerance will be adjusted to flag approximately 5% of the surveys.

TABLE 2. Parameters Used for Flagging Questionable Data

variable	reported/derived	correlates to:
moisture content	reported	type of waste
plant throughput	reported	type of commodity
waste/product ratio	derived	type of commodity
peak processing month	derived	type of commodity, region

Procedure for Establishing Follow-up Contacts

Copies of all flagged survey responses will be promptly returned to NFPA along with a description of the indicated discrepancy. The returned survey responses will be attached to a completed "Survey Follow-up Request" (SFR), which is included as Exhibit 2. This form will be used by both BNW and NFPA to track flagged surveys during the follow-up process. A unique follow-up reference number will be assigned to each SFR by BNW upon initiation of a follow-up request. This identification number will include the plant code to provide further traceability. Each SFR which is initiated by BNW will be logged into a "Follow-up Request Log", which is included as Exhibit 3.

After receiving and logging the SFR, NFPA staff will follow up with a written and/or telephone communication with the survey respondent in order to clarify the discrepancy. Site visits may also be used to clarify information from the survey form.

After investigating the discrepancy, NFPA will complete the SFR and return it to BNW. The completed form will contain a brief explanation of any discrepancy, along with any changes to the original survey response. The revised data will then be entered into the database, and appropriate notations made in the database change log.

If the follow-up communication does not resolve the discrepancy, the data will be remain in the database in its original form, under the assumption that some plants may be run in highly unusual configurations. Data fields will be set aside in the database to identify and annotate records which require follow-up contacts.

Maintaining the Integrity of Data During Transfer to the Database

The most effective means of insuring the integrity of data during transfer from the survey responses to the computerized database is to incorporate well-designed user interfaces into the database. A key aspect to this approach is the design of input "forms" which are similar in appearance to the survey forms. In this technique, the data can be easily compared to the printed survey form. The data is then transferred by the program to the database. Figure 2 illustrates the flow of information during the processing of survey response data.

The capability to produce data entry forms is integral to the dBASE III Plus software, which provides a complete programming language for creating the forms. The programming language allows the incorporation of internal data "filters", which allow only certain values or ranges of values to be entered for selected data ranges. An example of this filtering would be the limiting of percentage data to the range of 0-100%. Other filters will check for consistency of units used in responses, and appropriate SIC codes.

A printed record will be generated for each record in the database. This record will echo the recorded data in a format which is very similar to that found on the survey forms. This output will be compared to the original survey and maintained as a project document and will be attached to the original survey form for storage. Any questions about the accuracy of the data transcription can then be answered quickly.

Database Maintenance and Protection of Data

Protecting the integrity of the database during data manipulation will be accomplished in several ways. The primary means of protection will be to limit access to the database and to protect the data from accidental erasure by maintaining duplicate copies on separate floppy disks.

Access to the database will be limited and controlled according to an adaptation of Pacific Northwest Laboratory's internal Software Control Procedures (SCP's), which were developed primarily for license related work. Specifically, access will be limited to users approved and trained in the use of the database by the project manager; a written log of all changes to the database will be maintained; and the project manger will approve any changes which are made to the database. A written log of all backup copies will also be maintained as a project record. The appropriate forms are included as Exhibits 4 and 5.

Once the data from the completed survey forms has been entered into the database, the data will be manipulated to develop useful tabulations of data by geographical area, season, RAC, and waste destination. In order to prevent the disruption of the database during this manipulation, the original database will not be changed during the required searches. Rather, the selected records will be exported via ASCII data files to a statistical analysis program, which will also run on an IBM-PC or compatible machine. These extracted data sets will be stored on disk for later reference. A printed listing of the search criteria, filename, and extracted data will be maintained for each such extracted data set.

Backup Copies

Duplicate copies (backups) of the database will be maintained by the Project Manager. During the creation of the database, backup copies will be made each time new records are added to the database. During the tabulation and manipulation of data, backup copies will be made on a bi-weekly basis. A

"hard copy" (ie, printed record) will be made for each of the bi-weekly backups. These will be kept on file until the termination of the project. The duplicate copies will be kept separate from the written records and also be physically separate from one another.

Training of Database Users

Access to the database, including data entry functions, will be strictly limited to the project manager and other personnel assigned by him. The project manager will provide a training session for all users of the database to familiarize them with the basic functions of the data entry program.

SUMMARY

Procedures have been developed to insure the quality of data collected from the Food Processing Solid Waste Characterization Survey. These procedures address the entry of data into the database, checks for internal and external consistency of the data, and survey follow-up procedures. Also discussed are standard procedures for protecting the integrity of the data in the database and procedures for backing up data. Each of these procedures will be implemented in order to provide the best possible information to EPA for use in determining the need for Food Additive Tolerance levels.

EXHIBIT 2. Example Survey Follow-up Request

FOLLOW-UP REFERENCE NUMBER: #2037-A

PLANT CODE NUMBER: #2037

RECORD NUMBER: 256

TODAY'S DATE: 12 / 04 / 87

DESCRIPTION OF PROBLEM:
(Indicate the reason for requesting follow-up contact with respondent. Include relevant question numbers, responses, or other information to identify problem. If more than one problem is reported, please number problems consecutively. Attach copy of completed survey if necessary).

EXAMPLE:

#1 Part II, page 2 of 3, Question 1.0, column 4; reported moisture content for apples is 13 wt%. This is substantially lower than normally reported.

#2 Part II, page 2 of 3, Question 1.0, column 5; reported processing weight for apples is 200,000,000 tons per year. Assume they meant tons per year?

(use additional sheets if required)

RECEIVED BY NFPA: 12 / 07 / 87

DATE OF FOLLOW-UP: 12 / 08 / 87

EXPLANATION:
(Explain source of problem if determined. Number responses when more than one problem is addressed. If new data is included, indicate original data and replacement data.)

#1 Reported solids content instead of moisture content. Replace 13 wt% with 87 wt %

#2 Reported value using wrong units. Replace 200,000,000 tons per year with 100,000 tons/year

EXHIBIT 3. Follow-up Request Log

FOLLOW-UP REFERENCE #	REASON FOR FOLLOW-UP	DATE SENT	DATE RET'D

EXHIBIT 4. Database Change Log

DATE	PLANT CODE	RAC#	DESCRIPTION AND REASON FOR CHANGE

EXHIBIT 5. Database Back-up Log

DATE	FILENAMES	LOCATION OF BACKUP

Appendix D. EPA/NFPA Food Processing Byproduct Survey Forms

National Food Processors Association

6363 Clark Ave.
Dublin, Calif. 94568-3097
415/828-2070

TO: Processors and Handlers of Raw Agricultural Commodities

FROM: Charles J. Carey, President, National Food Processors Association

SUBJECT: EPA Food Processing Byproduct Survey

When Raw Agricultural Commodities (RAC's) are converted into food products or ingredients for human consumption, certain portions are removed to be discarded as waste byproducts. Some or all of the waste byproduct may be used as animal feed or disposed of in some other way.

Your participation in this survey will aid your industry in the safe disposal of wastes from processing RAC's. It will help to assure that no overtolerances of pesticide residues in meat, milk, poultry, or eggs will occur from feeding solid waste byproducts from your plant. Information that will allow the U.S. Environmental Protection Agency (EPA) to properly assess the risk of pesticide residues in RAC waste byproducts may allow continued or increased use for animal feed.

The EPA Office of Pesticide Programs desires this survey to adequately assess the level of pesticides in RAC waste byproducts fed to animals producing meat, milk, poultry, and eggs. For this reason, the EPA has obtained NFPA assistance to conduct the survey and to ensure that accurate information is collected for the purpose of updating EPA's database for tolerance setting. Current EPA data are based on a survey made by NFPA 15 years ago and needs to be updated. The survey will include processors and handlers of RAC's, including cereal grains, sugar crops, legumes, root crops, fruiting vegetables, fruits, oil and fiber crops.

Confidential business information collected will be handled in a manner that will maintain its confidentialty. Published data will be presented in a way that will not identify it with any individual company. All data collected will be reported so that only the overall status of pesticide residues in RAC waste byproducts used for feed will be known.

Please complete these enclosed forms at your earliest convenience for each RAC for each respective plant. Return the completed forms in the enclosed, self-addressed envelope **by December 16, 1988.** Forms may be duplicated. If more forms are needed or if there are any questions, please contact Leo Pedersen or Wally Rose at (415) 828-2070 at NFPA, 6363 Clark Avenue, Dublin, California 94568. Your cooperation is greatly appreciated.

HR:ceh/5C:46
Enclosures

1988 EPA FOOD PROCESSING BYPRODUCT SURVEY
Part I: Confidential Information, Page 1 of 1

Form Approved OMB No. 2070-0097 Expires 9/30/1989

1. Plant Code No. _____

2. Region _____
For NFPA use only

Please type or print legibly.

3. Company	4. Plant No.
5. Street/P.O. Box	6. City/County
7. State/ZIP	8. Telephone Number
9. Contact Person	10. Title
11. Address if different than above	Today's Date

12. Standard Industry Classification(s) (from attached list)

_____ _____ _____ _____ _____

Raw Agricultural Commodity(ies) (RAC) Processed at This Plant

13. RAC	14. State or Country of Origin	15. Product(s) Produced
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		

If more RAC's are processed, please duplicate page and continue list.

ceh/1F:2

STANDARD INDUSTRY CLASSIFICATION (SIC) NUMBERS FOR ESTABLISHMENTS INCLUDED IN THIS EPA SURVEY

Please enter the appropriate SIC number or numbers for your plant as item 12 on page 1, Part I.

SIC No.	Description
2032	**Canned Specialties:** Baby food, baked beans, Chinese foods, Mexican food, puddings.
2033	**Canned Fruits, Vegetables, Preserves, Jams and Jellies:** Canned fruits, vegetables, juices, tomatoes and tomato products, olives, etc. in cans or glass.
2034	**Dried and Dehydrated Fruits, Vegetables, and Soup Mixes:** Dried fruits, nuts, beans, potatoes, and other vegetables.
2035	**Pickled Fruits and Vegetables, Vegetable Sauces and Seasonings, and Salad Dressings:** Brined fruits and vegetables, brined cherries, olives, pickles, relish, etc.
2037	**Frozen Fruits, Fruit Juices, and Vegetables:** Frozen fruits and vegetables, frozen fruit and vegetable juices and concentrates.
2038	**Frozen Specialities:** Frozen food specialties, frozen soups, frozen meals using RAC's.
2041	**Flour and Other Grain Mill Products:** Grain mills producing flour from buckwheat, corn, rye, and wheat as we as other grain mill products.
2043	**Cereal Breakfast Foods:** Cornflakes, hominy, oatmeal, wheat flakes from whole grains.
2044	**Rice Milling:** Mills producing rice flour and other rice products.
2046	**Wet Corn Milling:** Mills producing corn syrup and sugar, corn oil, corn starch, rice starch, potato starch, tapioca, and wheat starch, etc.
2061	**Cane Sugar, Except Refining Only:** Raw sugar and molasses from sugar cane.
2063	**Beet Sugar:** Sugar, molasses, and dried beet pulp.
2065	**Candy and Confectioners Products:** Peanut, nut, and seed processing operations found here.
2066	**Chocolate and Cocoa Products:** Cocoa bean shelling, roasting, and grinding for making chocolate.
2074	**Cottonseed Oil Mills:** Cottonseed oil, cake, and meal.
2075	**Soybean Oil Mills:** Soybean oil, cake, and meal, lecithin.
2076	**Vegetable Oil Mills, Except Corn, Cottonseed and Soybean:** Castor oil, coconut oil, linseed oil, peanut oil, safflower oil, vegetable tallow, etc.
2079	**Shortening, Table Oils, and Other Fats and Oils Not Elsewhere Classified:** Olive oil.
2082	**Malt Beverages:** Breweries producing beer, ale, brewers grits, malt extracts, etc.
2083	**Malt:** Malt products from barley, rye, wheat, and corn.
2084	**Wines, Brandy, and Brandy Spirits:** Establishments producing and blending wines and brandies.
2085	**Distilled, Rectified, and Blended Liquors:** Establishments manufacturing alcoholic liquors by distillation and rectification. Bourbon, rye, scotch, corn, neutral spirits except fruit.
2087	**Flavoring Extracts and Flavoring Syrups Not Elsewhere Classified:** Flavoring concentrates, beverage bases.
2095	**Roasted Coffee:** Coffee roasting, grinding, instant and freeze-dried coffee.
2099	**Food Preparations Not Elsewhere Classified:** Producers of corn chips, potato chips, pectin, spice cleaning, grinding and blending, tea, etc.
4221	**Farm Products Warehouse and Storage:** Bean cleaning and storage, bean elevators, grain elevators, potato storage, etc.

1988 EPA FOOD PROCESSING BYPRODUCT SURVEY
Preparation Instructions for Part II

Page 1: Please describe the raw agricultural commodity (RAC) as it enters the plant, e.g., a root with or without leaves; corn with or without husk; nuts with or without shells; vegetables with or without foilage.

Show weight in pounds or tons (please specify) processed by month during your last season or production year. Show total for year on an annual basis.

Space is provided for 10 RAC's. If more space is needed, duplicate page or request additional copies from us.

Page 2: Please complete for each RAC processed. *Note: Responders need only submit readily available information and there is no need to recalculate data in order to address any part of the survey.* *Separate data sheets* are required for each RAC used in a mixture to produce a food for humans (e.g., fruit cocktail, mixed vegetables, flour blends). *Separate data sheets* are also required where the same RAC is used to produce different human foods with different waste products (e.g., applesauce or apple juice). When waste products are combined, then one data sheet is needed. Duplicate page as needed or request additional copies from us.

Column 2 identifies possible distribution of the various parts of a RAC. Any distribution not shown should be listed under "Other."

Column 3:	Line 1.0:	Describe the RAC received by the plant.
	Line 1.1:	List human food product or products produced from RAC.
	Line 1.2:	List the wet waste byproduct(s) used for animal feed or ensilage (e.g., seed, skin husks, cobs, etc.).
	Line 1.3:	List the dried waste byproduct(s) used for animal feed (e.g., dry citrus pulp, sugar beet pulp, spent hops, etc.).
	Line 1.4:	List the waste byproduct(s) used as soil conditioner.
	Line 1.5:	List the waste byproduct(s) burned as fuel.
	Line 1.6:	List the waste byproduct(s) buried in landfill.
	Line 1.7:	List undetermined losses (e.g., lost soluble solids, etc.).
	Line 1.8:	List waste byproduct(s) and describe uses not listed above (e.g., alcohol, biogas, charcoal, etc.).
	Line 1.9:	Same as 1.8.
	Line 2.1:	Describe parts of RAC left after harvest.
	Line 2.2:	Describe parts of RAC left after harvest.
	Line 2.3:	Describe parts of RAC left after harvest.
Column 4:	All lines:	Show percentage of moisture for each product or byproduct: % w/w.
Column 5:	All lines:	Show weight used for each raw product(s) and waste byproducts produced. Circle reporting weight, pounds or tons.
Column 6:	All lines:	Show percent by weight for product(s) and byproducts produced from the RAC.
Column 7:		Show type of animal(s) fed, if known (e.g., beef cattle, hogs, etc.).

An example of a completed page 2 is shown on the back of page 2.

Page 3: Draw or attach a simplified diagram for each RAC as it enters the plant through final processing. Show where byproducts are generated. If possible, cite published literature describing the processing of each RAC. Use commonly used terms to describe the production processes.

An example of a completed page 3 is shown on the back of page 3.

–CONFIDENTIAL–

Plant Code No. _____

Region _____
For NFPA use only

1988 EPA FOOD PROCESSING BYPRODUCT SURVEY
Part II, Page 1 of 3

Instructions: Show, for the appropriate month, the total weight of each raw agricultural commodity (RAC) received by this plant and processed during the last completed year. Show total weight processed for the year or season in the "Total" column. Report weight in pounds or tons. Circle reporting method: Pounds/Tons

Type or print legibly

RAW AGRICULTURAL PRODUCTS PROCESSED BY THIS PLANT													
RAC	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total annual wt.
1.													
2.													
3.													
4.													
5.													
6.													
7.													
8.													
9.													
10.													

ceh/1F:5

– CONFIDENTIAL –

Plant Code No. _____

Region _____
For NFPA use only

1988 EPA FOOD PROCESSING BYPRODUCT SURVEY
Part II, Page 2 of 3

Please complete one sheet for each raw agricultural commodity (RAC) processed. Duplicate page as needed or request additional copies. Circle method for reporting weight: Pounds/Tons

Type or print legibly

Column 2	3 Part(s) used or product(s) produced	4 Avg. percent moisture	5 Annual Total weight lbs/tons	6 Percent by weight	7 Animal(s) fed
1.0 RAC					
1.1 Processed human food					
1.2 Animal feed or ensilage, wet					
1.3 Animal feed, dry					
1.4 Soil conditioner					
1.5 Burned for fuel					
1.6 Buried (landfill, etc.)					
1.7 Undetermined losses					
1.8 Other[a] _____					
1.9 Other[a] _____					
2.1 Field residue: animal feed[b]					
2.2 Field residue: soil conditioner[b]					
2.3 Field residue: burned[b]					

[a] List of other products or byproducts produced from RAC, RAC byproducts, or waste not listed.
[b] Estimate weight of residue remaining in field and how it is disposed.

See back of this page for an example of completed form.

-- CONFIDENTIAL --

Plant Code No. _____

Region _____
For NFPA use only

1988 EPA FOOD PROCESSING BYPRODUCT SURVEY
Part II, Page 2 of 3

Please complete one sheet for each raw agricultural commodity (RAC) processed. Duplicate page as needed or request additional copies. Circle method for reporting weight: Pounds (Tons)

Type or print legibly

Column 2	3 Part(s) used or product(s) produced	4 Avg. percent moisture	5 Annual Total weight lbs (tons)	6 Percent by weight	7 Animal(s) fed
1.0 RAC	Apples - Whole, field run	83	65,050		
1.1 Processed human food	Apple Sauce, Apple Juice, Sliced Apples in can & glass	86	51,390	79	
1.2 Animal feed or ensilage, wet	Peel, cores, culls, Apple Pomace	80	3,900	6	pigs, beef cattle
1.3 Animal feed, dry	N/A				
1.4 Soil conditioner	Peel, cores, culls, Apple Pomace	80	3,900	6	
1.5 Burned for fuel	N/A				
1.6 Buried (landfill, etc.)	Peel, cores, culls, Apple Pomace, Leaves	80	4,554	7	
1.7 Undetermined losses	drippage, spillage		1,306	2	
1.8 Other[a] Apple wine	Apple Pomace	65	N/A		
1.9 Other[a] _____					
2.1 Field residue: animal feed[b]					
2.2 Field residue: soil conditioner[b]	Leaves, Apples	N/A	N/A		
2.3 Field residue: burned[b]					

[a] List of other products or byproducts produced from RAC, RAC byproducts, or waste not listed.
[b] Estimate weight of residue remaining in field and how it is disposed.

Plant Code No. _____

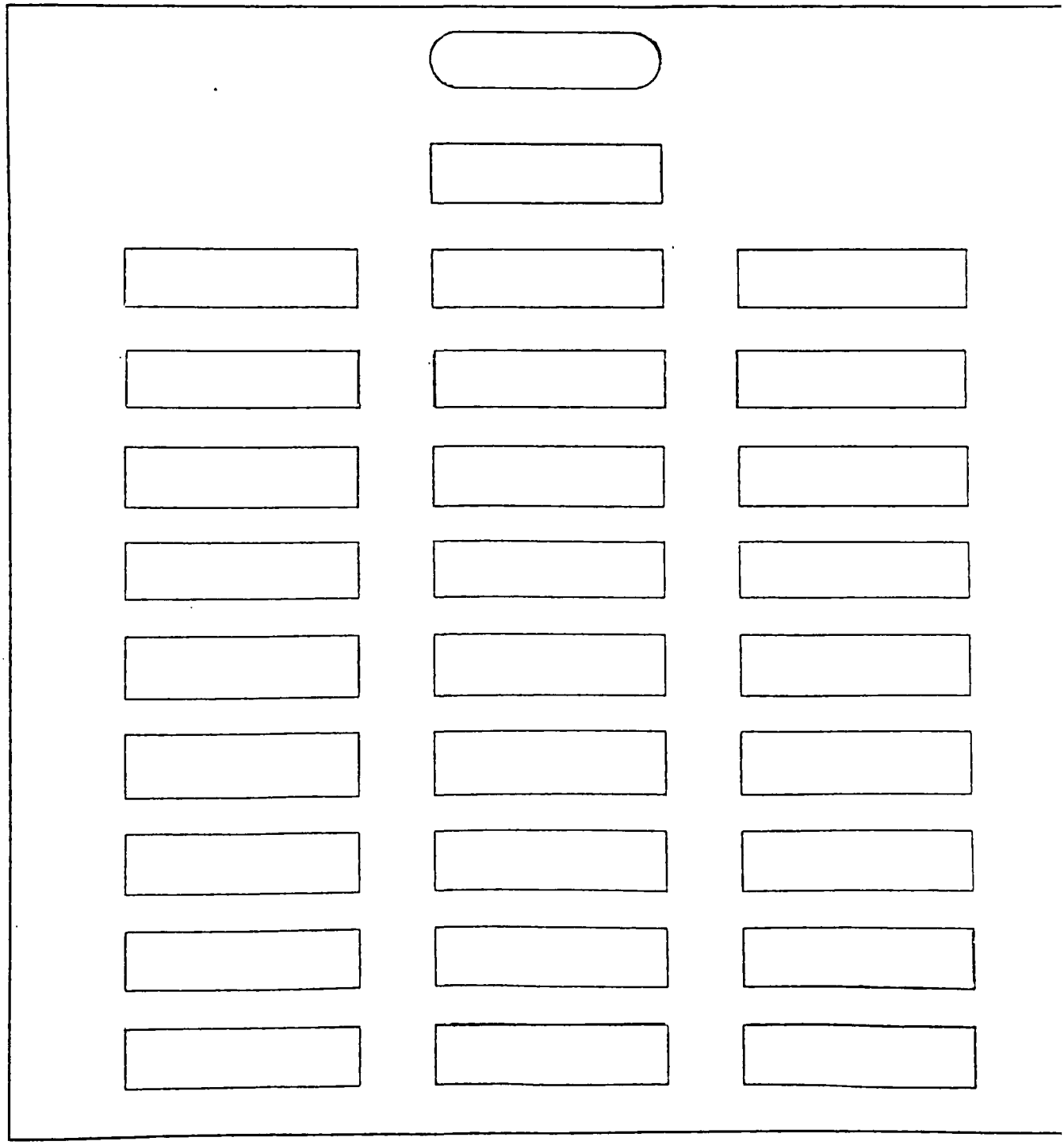
Region _____
For NFPA use only

-- CONFIDENTIAL --

1988 EPA FOOD PROCESSING BYPRODUCT SURVEY

Part II, Page 3 of 3

Please draw a simplified process flow diagram for each RAC processed. indicating sources of waste byproducts. Cite any published literature describing the processing of the RAC(s) you process.



See example on back.

ceh/1F:7

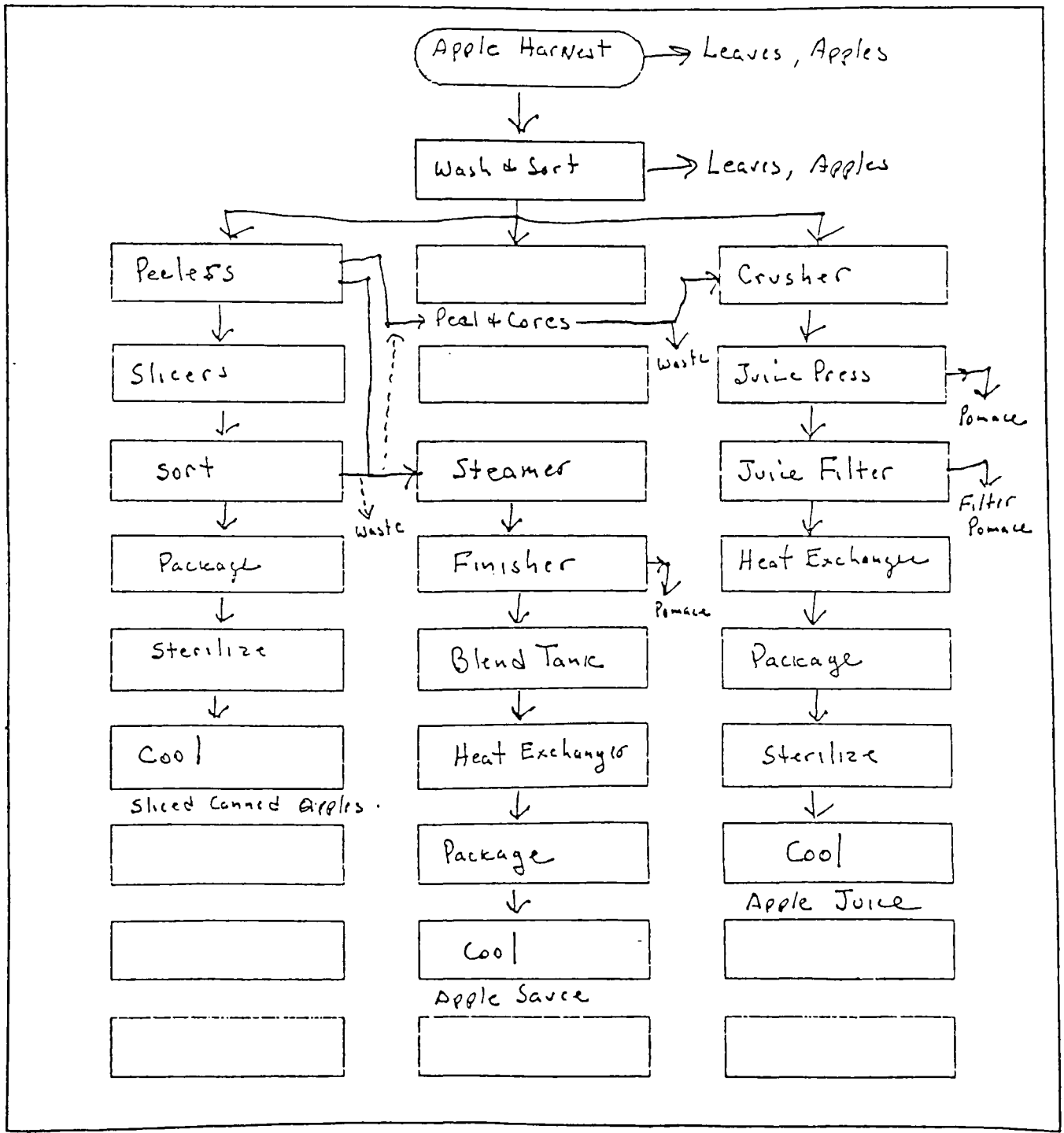
Plant Code No. _____

Region _____
For NFPA use only

-- CONFIDENTIAL --

1988 EPA FOOD PROCESSING BYPRODUCT SURVEY

Please draw a simplified process flow diagram for each RAC processed. indicating sources of waste byproducts. Cite any published literature describing the processing of the RAC(s) you process.



Reference: A Complete Course in Canning
Anthony Lopez
The Canning Trade 1981

See example on back.

cch/1F:7

-- CONFIDENTIAL --

1988 EPA FOOD PROCESSING BYPRODUCT SURVEY
Part III

1. **Research needs**

Do you feel more research should be devoted towards disposal and/or utilization of food processing wastes?

☐ Yes ☐ No

If your answer is yes, which of the following would you like to see investigated? (You may indicate more than one.)

☐ Energy production from waste and byproducts.

☐ New food products from waste and byproducts.

☐ Better utilization of waste and byproducts for animal feed.

☐ Process modification to reduce waste and byproduct production.

☐ Treatment of wastewater streams.

☐ Other (please explain):

_____

_____

_____

_____

2. Does your plant monitor for pesticide residues in or on RAC(s) and/or its (their) processed byproduct?

☐ Yes ☐ No

If your plant does monitor for pesticide residues on the RAC(s) and/or processed byproduct(s), would you be willing to share the data with NFPA?

☐ Yes ☐ No ☐ No comment

3. **Other remarks:** Any additional information pertinent to this survey and/or comments regarding this questionnaire would be greatly appreciated. If additional space is required, please attach a separate page.

_____

_____

_____

_____

National Food Processors Association

6363 Clark Ave.
Dublin, Calif. 94568-3097
415/828-2070

TO: PROCESSORS AND HANDLERS OF RAW AGRICULTURAL COMMODITIES

FROM: WALTER W. ROSE WWR

SUBJECT: 1988 EPA FOOD PROCESSING BYPRODUCT SURVEY

DATE: JANUARY 2, 1989

This is a follow-up to remind you to please complete and submit the 1988 EPA Food Processing Byproducts Survey forms sent you in November of 1988. If you have already sent it to us, then disregard this reminder.

If you have not completed and submitted the survey forms, we urge you to do so as soon as possible. Your participation in this survey will aid the food industry in the safe disposal of wastes from processing RAC's (Raw Agricultural Commodities). Survey information will allow the U.S. Environmental Protection Agency (EPA) to properly assess the risk of pesticide residues in RAC byproducts used for animal feed. This information is needed by EPA so that tolerances for pesticide residues in RAC byproducts fed to animals may be appropriately established.

Even if you do not handle RAC's, please complete the first page of the survey form showing products you produce. Such information helps determine which SIC (Standard Industry Classification) group does not handle RAC's that may contain pesticide residues. This information is important to EPA for future planning purposes.

Confidential business information will be handled in a manner that will maintain its confidentiality. Published data will be presented only in a form that will not identify it with any individual company. All data collected will be reported so that only the overall status of RAC waste by products used for feed will be known.

If you have lost or misplaced the survey forms originally sent you, we would be happy to send you another set. Call Leo Pedersen or Wally Rose at (415) 828-2070 for survey forms or for information about this survey. Your cooperation is greatly appreciated.

WWR:kh/84:26