Weight sampling for SIZE MEASUREMENT *of* BARTLETT PEARS *for* CANNING

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Recent legislation has authorized Federal Marketing Order standards for all Pacific Coast Bartlett pears. If size standards are invoked, they should take into account any variations in shape of pears produced in different districts. Study of fruit measurements in California suggests that sizes of Bartlett pears for canning may be determined satisfactorily by sorting the pears in a sample according to weight. This method has several advantages over the present one based on minimum diameters.

THE SIZING of Bartlett pears sold for canning in California is based on minimum diameter at the large end of the pear. A tolerance is usually allowed for pears with a specified range of smaller diameters, below which the pears are considered to be culls. Long pears are preferred for canning halves, but otherwise no consideration is given to the relation of length or of weight to diameter. Also, no consideration is given to oversize pears, which are undesirable as canning halves but which can be cubed for cocktail mixes with minimum waste.

Bartlett pears grown in Washington State generally appear longer and reportedly have greater length-to-diameter ratios than those produced in the pear regions of California. Also, it is commonly believed that California grown Bartletts of a given diameter may vary significantly in both length and weight according to the district in which they are grown. If this conclusion is substantiated then certain price adjustments according to size and weight might be in order. Previous studies have indicated that climate is the most important factor influencing the shape of Bartlett pears, although seed content, age of tree, and pruning and training methods may have some influence. Little quantitative information has been developed, however, on the relation between weight, length, and diameter of pears in different orchards, districts, and years. The drawing shows typical variations in the shape of Bartlett pears.

In view of recent legislation which authorizes federal marketing order standards for all Pacific Coast Bartlett pears, authorities of Pear Zone, a marketing program for California processing pear growers, are interested in obtaining information on the relation of diameter-to-weight of pears produced in different regions and districts. They wonder if a weight-count standard, as used for a number of other fruits, would give a more accurate expression of the true volume and commercial value of pears than standards based on fruit diameters. Certainly growers in areas in which pears of a given diameter may be longer and heavier would be reluctant to accept a standard which would permit the delivery of smaller pears from another area. To gather information of possible commercial importance, particularly on the relation of weight to diameter, authorities of Pear Zone arranged (in 1972) for weighing and counting of 2¼ to 2⅜-inch diameter pears, which are routinely segregated at their inspection stations. To supplement this data, pears of given diameters were selected from measurements of individual pears made during a University of California study of shapes of Bartlett pears produced in the major California pear districts from 1948 through 1950.

Table 1 shows the range of diameters of pears selected for study in each year and their average weights and lengths. Because there were small year-to-year differences in the diameters of pears available for study, the weights and lengths measured in each year were expressed as percentages of the average weight and length for that year. This allowed valid comparisons of the relative standings of orchards and of districts from year to year, regardless of small year-to-year differences in diameters. There was the further advantage that the approximate percentages by which weights or lengths differed from each other could be seen by direct subtraction of the figures in tables 2, 3, and 4.

Relative weights

Table 2 shows relative weights of pears by districts and years and the 4-year average for each district. Disregarding the Glenn-Butte district, for which data are available for one year only, the lightest and heaviest 4-year averages differ from the overall average by (respectively) 2% and 3%. This is less than the year-to-year differences in several of the district weights. It is noteworthy that there is no district in which the pears were consistently heavier or lighter than the average for all districts. There appears to be no consistent relationship between geographical location and the 4-year average weights.

Table 3 shows comparative weights and lengths of pears in 23 orchards in 1948, the year in which most orchards were studied. Weights and lengths for corresponding orchards are in corresponding positions in the table. The weight differences between orchards in the same district are greater than the differences between districts. Corresponding weights and lengths that differ from each

TABLE 1. DIAMETERS OF BARTLETT PEARS STUDIED AND SEASONAL AVERAGE WEIGHTS AND LENGTHS (USED AS 100% IN TABLES 2, 3, AND 4)

Year	1948	1949	1950	1972
Diameter range (inches)	2.48–2.52	2.24–2.38	2.24–2.38	2.25–2.38
Average weight (lb)	0.333	0.284	0.284	0.260
Average length (inches)	2.95	3.11	3.04	——
Average length/ diameter ratio	1.18	1.34	1.32	——

TABLE 2. COMPARATIVE WEIGHTS OF BARTLETT PEARS STUDIED BY CALIFORNIA DISTRICTS AND YEARS

District (counties)	Orchards			Stations	4-year average
	1948	1949	1950	1972	
	Weights as percent of season's average				
Glenn-Butte	—	—	—	96	96
Mendocino	92	98	101	102	98
Santa Clara	96	100	100	98	99
Solano	101	99	98	99	99
Contra Costa	102	98	98	99	99
Placer	99	102	97	100	100
Sacramento	103	93	103	100	100
San Joaquin	—	102	99	100	100
Sutter-Yuba	103	101	98	98	100
Napa-Sonoma	—	104	98	101	101
El Dorado	98	101	107	102	102
Lake	102	103	99	109	103

other by more than 3% are underlined, to indicate the extent of irregularities in the weight-length relationship of pears of the same diameter.

Table 4 shows comparative weights and lengths by years for seven orchards sampled in each of the three years of the study. Two orchards (1 and 22), produced pears in these years that were consistently heavier in relation to diameter than the average. Whether this was a characteristic of the orchards or due to chance is not known. The remaining five orchards produced pears that were heavier than average in relation to diameter in some years and lighter in other years.

In summary, pears of the same diameter appeared to vary sufficiently in weight (and presumably in net volume after processing), to make diameter an unsatisfactory basis for size standards, or for pricing. It was evident that variations in the weight-to-diameter relationship from orchard to orchard and from year to year precluded any fixed district-to-district differentials in size standards or prices.

Use of pear weights for size standards and for pricing was studied by plotting the weights and diameters of individual pears, in a sample representative of orchards producing a range of sizes. The resulting plot is shown in the graph. The circles represent a randomized sample of 100 pears from an orchard in which the pears were unusually large in the year the sample was taken. The solid dots represent 100 pears from an orchard in which the pears were unusually small in

TABLE 3. COMPARATIVE WEIGHTS AND LENGTHS OF BARTLETT PEARS OF STUDIED DIAMETERS IN ALL ORCHARDS SAMPLED IN 1948

District (counties)	Weight (% of season average of all orchards)						Length (% of season average of all orchards)					
	Orchards					District	Orchards					District
Mendocino	91	93				92	93	94				93
Santa Clara	90*	93	95	98	106	98	95	95	98	104	107	100
El Dorado	98					98	95					95
Placer	93	100	104			99	95	98	98			97
Solano	97	102	105			101	100	102	101			101
Contra Costa	100	105				102	101	104				102
Sutter-Yuba	99	107				102	101	107				104
Lake	102	102				102	104	109				106
Sacramento	102	103	105			103	104	104	101			103

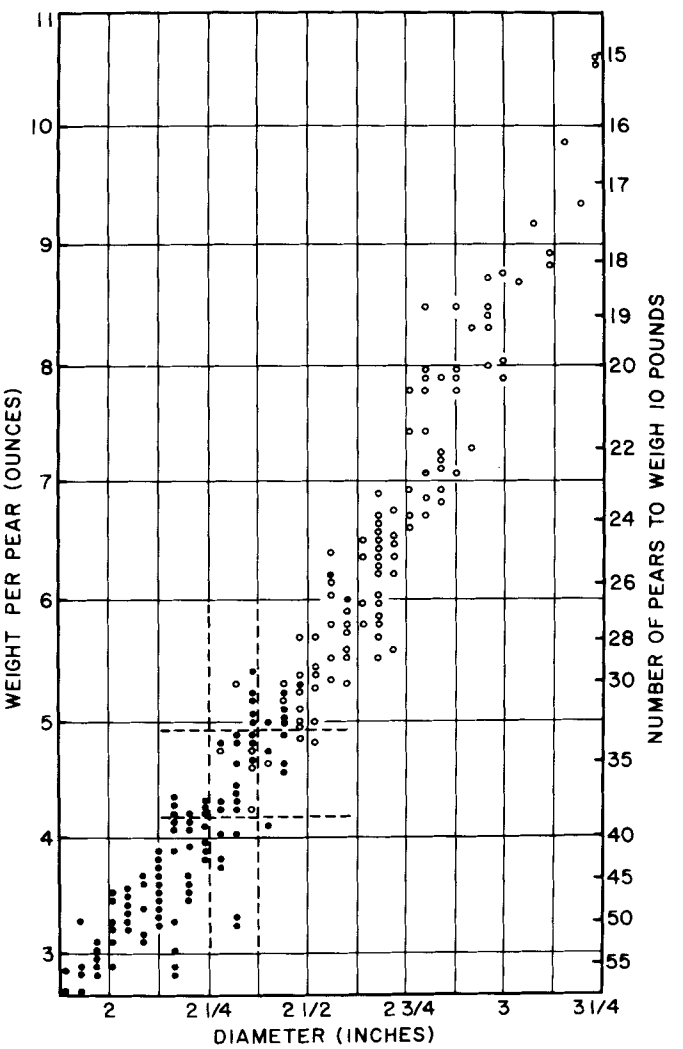
* Corresponding weights and lengths differing by more than 3% are underlined.

TABLE 4. COMPARATIVE WEIGHTS AND LENGTHS OF BARTLETT PEARS OF STUDIED DIAMETERS FROM SEVEN ORCHARDS SAMPLED IN 1948, 1949, AND 1950

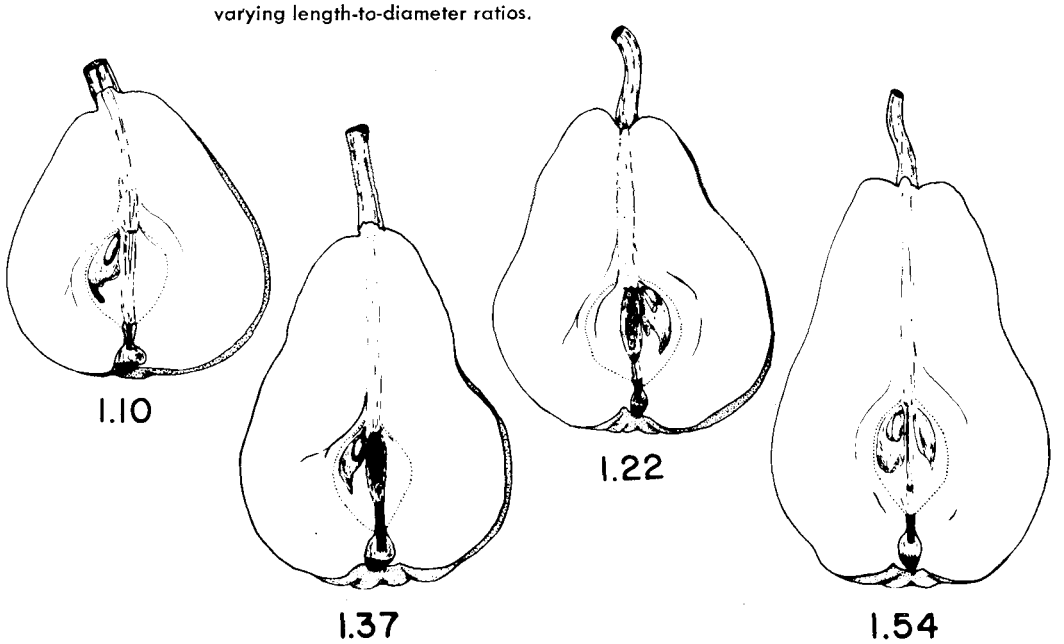
Orchard Number	District (Counties)	Weight (% of season average of all orchards)				Length (% of season average of all orchards)			
		1948	1949	1950	3-year average	1948	1949	1950	3-year average
13	Placer	93	102	92	96	95	101	94	97
25	Mendocino	93	101	98	97	93	102	101	97
7	Sutter-Yuba	99	100*	93	97	101	104	96	100
5	Contra Costa	105	98	98	100	104	100	94	99
18	Sacramento	103	93	103	100	104	91	104	100
22	Sutter-Yuba	107	102	102	104	107	103	101	104
1	Santa Clara	106	104	109	106	107	100	107	105

* Corresponding weights and lengths differing by more than 3% are underlined.

Diameters and weights of random samples of pears from an orchard producing unusually large fruit (circles) and an orchard producing unusually small fruit (solid dots).



Longitudinal sections of Bartlett pears showing different shapes under varying length-to-diameter ratios.



the year the sample was taken. Current standards and pricing consider that all pears to the right of the 2⅜-inch diameter line, and free from defects, were acceptable. A tolerance was allowed for those between 2¼ and 2⅜ inches in diameter and all to the left of the 2¼-inch diameter line were rejected.

Counting the pears in a weighed sample was considered first. This was a quick and accurate measure of average size and very useful where the range of sizes was limited, as in the outputs of mechanical sizers. However, although 20% of the pears in this lot were under 2¼ inches in diameter and also were lighter than the 2¼-inch pears, enough large pears were in the lot to raise the average weight to that of 2½-inch pears. An average weight determined by weight-count was evidently not suitable for such a situation.

Sorting samples of pears by weight, much as they are now sorted by diameter, might serve as a basis for size standards and for pricing. The weight of individual pears could be estimated by eye and checked on small tipple scales about as quickly and perhaps more accurately than diameters can be checked by ringing. Small mechanical sizers, similar in principle to the full-scale weight sizers now available for various fruits, might be used at inspection stations where larger volumes are handled.

Referring again to the graph, horizontal dashed lines drawn at 4.9 ounces and 4.2 ounces can segregate virtually the same numbers and weights of pears as acceptable, and as subject to tolerances, as do the vertical lines at 2⅜ and 2¼ inches, with this particular sample. This sample was about average in the relation of the weights of the pears to their diameters. The weight segregation would rate more pears as acceptable if they averaged heavier in relation to their diameters, or fewer pears as acceptable if they averaged lighter in relation to their diameters. Trials indicate that segregation by weights instead of by diameters would change the fraction of a sample rated as acceptable by roughly one percent for each one percent difference in average weight of the pears in relation to their diameters.

Weight segregation of samples as a basis for size standards and for pricing appears to be entirely practicable and could even expedite inspection at stations where volume justified the use of mechanical sizers. Segregation of average fruit could be very similar to that resulting from current diameter standards. Most important, weight segregation would avoid any controversy between growers or producing areas regarding failure of diameter standards to reflect the true weight of the pears.

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VIGOR IN LETTUCE SEEDS UNDER ADVERSE STORAGE CONDITIONS

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LETTUCE SEEDS that have a high germination percentage are not always high in vigor. Low vigor seeds may germinate and emerge from the soil acceptably under favorable conditions, but under unfavorable situations they perform poorly. In recent years, most lettuce growers in the central coast area of California have been using reduced seeding or precision planting techniques. With a reduction in the number of seeds planted per acre, the quality of seeds both in terms of germination and vigor becomes more critical. Rapid emergence of seedlings during the critical stages of emergence, and establishment of the tender plant, is important to help reduce stand losses due to soil crusting, insect and fungi attack.

In past years, considerable information has been collected on the effects of storage conditions upon germination, but little work has been done to determine the effects upon vigor. Adverse storage conditions such as high heat, relatively high humidity, and a combination of both can occur before seed is thrashed. Humid weather such as heavy dew or rain followed by hot weather can seriously reduce vigor in lettuce seeds. Seeds high in moisture, stored in non-insulated sheds, or partially emptied