

Is Decay of Oranges in Transit Necessary?

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Mr. President, Ladies and Gentlemen:

The ultimate end of commercial fruit growing is to make money. With a very limited supply and a large demand for any particular fruit, no difficulty is found in realizing this end. This has been true in the citrus industry. But with the growth of refrigeration and the extension of the railroads, production has increased, and the tendency is for profits to diminish. There comes a time finally when the minutest details must be looked after in order that the profits may be large enough to keep the industry alive.

In 1894 when Florida reached high water mark in citrus production, Southern California was shipping annually less than two million boxes of oranges and lemons. The Tulare district in California was then unplanted. Shipments from Cuba and Porto Rico were so few as to influence but little the market conditions. Then came the freeze and Florida was practically eliminated for the time being as a large producing state. Fourteen years have passed and once again Florida looks forward to a record-breaking crop. During these years, however, great changes have been made in the orange producing sections. Southern California is, this year, shipping nearly or quite 30 thousand cars or over 11 million boxes of oranges and lemons. Tulare county has now an annual production of about two thousand cars; new

plantings have been made which, under favorable condition, may increase the production in that section to 10 thousand cars, or about four million boxes. Cuba has been pushing forward in its planting, and while no reliable information is at hand, doubtless between 8 and 10 thousand acres have been planted. Porto Rico, also, has extensive plantings that run up into the thousands of acres. I do not wish to discourage you orange growers, or to make you think there will be no market for your fruit. With the increase of production, there has come a large increase of demand. Hundreds of small towns over the country that now have oranges in their stores throughout the season scarcely saw a box of the fruit in 1894. The quantity eaten in the large cities has also been very largely increased during these years. It is safe to say that with a proper distribution of the fruit, fair profits might be made by all growers, *provided only the fruit could be placed on the market in a sound condition*, and with a feeling in the minds of the buyers that they could hold the fruit ten days or two weeks with only a reasonable amount of decay.

This leads us to ask the question, "Is it necessary to have decay of oranges in transit?" or "What is the length of time that oranges should be expected to keep after being packed?"

Two years ago the Department of Ag-

riculture at Washington began the study of conditions in this State to see if these questions could be answered. Previous to that time considerable work had been done in California, and some very definite results obtained. These have recently been published in Bulletin 123, Bureau of Plant Industry, U. S. Department of Agriculture, entitled, *The Decay of Oranges While in Transit from California*, by G. Harold Powell and several assistants. At the last annual meeting of this society held at St. Petersburg, I had the pleasure of outlining our experiments in Florida and giving the results we had secured up to that time. The investigation has been continued during the past season and valuable additional data secured.

Briefly stated, the losses from decay of oranges while in transit from Florida amount annually to one-half or three-quarter million dollars. The principal loss is due to a decay or rot which is produced by the growth of a mold or fungus within the tissue of the orange. The most common fungus is a species of *penicillium*. This trouble cannot be called a disease for sound, healthy fruit is not attacked by the fungus and seldom rots. It seems to be necessary first to puncture the rind of the fruit, or to bruise it in some way sufficient to kill the tissue. If now the seed of the fungus are present at this injured place, the first step toward decay has been taken and if the temperature and moisture conditions during the following few days are suitable for the development of the fungus, the orange is sure to rot. On the other hand, large quantities of fruit have been held experimentally under weather conditions most favorable for the development of decay, yet when the fruit has been carefully

handled and the skin of the orange has been uninjured, there has been practically no loss, even when the spores or seed of the fungus have been purposely placed over the surface of the fruit.

This belief is not a theory or a laboratory scheme. In 1905, experiment work conducted in six packing houses in California, holding the fruit for two weeks under the most trying conditions, frequently in a lemon-curing room, so that often from 50 to 100 per cent. of the injured fruit decayed, yet the average decay for all the sound uninjured lots was only 4.9 per cent. In 1906, the experiments were in 15 houses and the average decay for the carefully handled fruit was 1.5 per cent. In 1907, the number of houses where work was done was increased to 31 and the average decay for sound fruit was 2.9 per cent. In addition to these experiments, where the fruit was held in the packing houses, last season 186 cars were shipped from California in which there were placed experimental lots of oranges. Under ventilation the sound fruit shipped immediately arrived in New York City with 1.4 per cent decay; under ice with 1.1 per cent. decay.

While these figures are for California oranges, yet we are finding that the same principles hold true in Florida. An orange without a cut or scratch on the skin and which has not been bruised in picking and packing, almost invariably keeps. Last season the carefully handled fruit held packed here in the Florida houses for two weeks, contained 2.9 per cent. decay. This present season the same lots showed 2.1 per cent. waste. This has been the first season for any shipping experiments from this State and the results show the very encouraging average of

only 0.4 per cent. rot on arrival at market for carefully handled sound fruit.

The work has now been carried far enough so that it seems safe to say that the Florida orange inherently is a good keeper. We can go even farther than this and say that it has been possible to pick, pack and ship the fruit in a way that has practically insured its safe arrival on the market. Judging from the past season's shipping experiments, it seems safe to say that any large percentage of decay in transit is not necessary.

The question then does not seem to be, "Is it possible for the Florida Orange to carry to market?" but rather "Is it practicable to handle the crop in such a way that the carrying quality has not been injured?" The first question seems to be well solved in our investigations and we have now turned our attention to the practicability of careful handling.

THE HANDLING IN THE ORCHARD.

Before there can be good carrying quality, there must be careful work in harvesting the fruit. Under the present conditions, a premium is placed on the amount of work done, rather than on the quality. In handling a tender perishable product, it is false economy to reduce the cost of an operation at the expense of the keeping quality. A laborer picking 75 boxes of oranges per day at five cents a box and injuring a quarter or more of it, and dropping the oranges several feet into his picking bag or box, is far more expensive than the one who picks 30 boxes for \$3.00 a day, but who does his work carefully.

There are three points that need careful attention by the picker. (1) the oranges should not be cut or punctured by the clippers, (2) the stems should be

cut short, (3) the fruit should be put in its place by hand and not thrown or dropped.

CLIPPER CUTTING.

The smooth round Florida orange can be cut from the tree with a short stem without injuring the fruit with the clippers more easily than can the California navel, which has a depression around the stem. Notwithstanding this, considerable damage is being done by clipper cutting. The amount of injury varies widely in different picking gangs.

CHART I.

Percentage of Clipper Cutting by Individual Pickers in One Gang.

0.0	8.0	12.8
2.6	10.0	26.0
3.4	11.0	36.7

Chart I shows the work of the individual pickers in one gang in Florida. Of the nine pickers, not more than one or two were doing satisfactory work. The average for the nine was over 12 per cent. cut fruit. Not all of these injured oranges would decay under ordinary shipping conditions. With conditions favorable for rot, however, a large percentage would go down. As a matter of fact, several boxes of the fruit picked by the two men showing the high percentages of clipper cuts, after being packed fourteen days, contained 21 per cent. waste, and the beginning of the decay could almost invariably be traced to the injury made by the clippers. Another lot of fruit selected from the more careful pickers and packed and held the same length of time and under the same conditions had 3 per cent. decay.

The clipper cutting indicated in Chart I is above the average for Florida. In

one small district counts were made at one time in four different orchards, with the following percentages of clipper cuts. 1.4 per cent., 1.6 per cent., 3.8 per cent., and 10.4 per cent. It is rather suggestive that of these, the first gang was paid by the day, while the last one was on box work. In another orchard two men were working together. Two boxes of fruit from each were examined. The first picker had cut but four oranges, while his companion had literally slaughtered 65.

In another place, the average injury done on a ranch, where the owner had everything under his direct control was slightly over 6 per cent. At a nearby packing house where the owner purchased all his fruit and had his picking done under the supervision of a foreman, the total injury found at one inspection was only 1.6 per cent. The difference lay in that on the first place the pickers worked largely by themselves, without proper instruction and inspection. The second foreman had been trained by us to watch for injury and had personally instructed each picker and inspected his work, until almost uniformly good work was done.

INJURIES OTHER THAN THOSE MADE BY CLIPPERS.

It is not necessary that the injury be made with the clippers in order to cause the fruit to decay. Any other abrasion through which the seed of the fungus can enter the fruit does the same damage. Frequently there are found oranges in the box that have been thorn punctured, scratched on the branches of the tree, cut by nails or splinters in the box, or injured by the finger nails. Many of these are made through carelessness

and haste on the part of the picker and therefore vary with individual pickers. The amount of thorn puncturing done while the fruit is still on the tree is surprisingly small or at least the decay which results from such puncturing is small. After a heavy wind decaying oranges may frequently be seen hanging on the trees. If the fruit is picked soon after such a storm, some punctured oranges are found. But more damage is done by "thorning" as the pickers pull the fruit from among the branches. In the gang referred to a short time ago as having a careful foreman 3 per cent. of the fruit had body bruises. In the different boxes there were all the way from 2 to 8 injured oranges. The fruit from four other pickers in another locality showed the following high percentages of body injuries. 7.6 per cent., 15 per cent., 22.4 per cent., and 23.6 per cent. Add to these injuries two or three oranges per box cut by the finger nails, and another two or three and frequently more bruised by nails or splinters in the box. A large amount of damage is possible therefore, before the fruit has left the grove on its journey to the market.

LONG STEMS.

Considerable emphasis in the past has been placed by orchard men on having the fruit cut with the stems short. It has been realized that an orange with a long sharp stem was capable of doing much damage. The long stem in itself causes no trouble; it is only when the stem has been brought into contact with another fruit and the rind punctured that damage is done. The amount of injury, therefore, depends largely on the extent and the nature of the handling of the fruit after picking. More puncturing is done if the fruit is dropped 18 inches or

two feet into the picking bag and then for an equal distance into the box, than would be if it were possible to lay the oranges carefully into the bag and box. A long haul over a rough road with a considerable number of oranges with long stems in boxes will do plenty of damage. It is not necessary to have much shaking of the fruit in the box in order to do puncturing, for the field crate used almost universally in Florida is so large that the weight of the fruit in the box is sufficient to force a sharp stem through the peeling of an adjacent orange near the bottom of the crate.

The number of long stems left by different pickers varies largely. Some pickers work steadily without leaving scarcely a long stem. Others cut practically all the stems too long. The following figures show the percentages left by different individuals. 5.9 per cent., 14 per cent., 18.8 per cent., 8.7 per cent., 15 per cent., 7 per cent., 14.1 per cent., 0.7 per cent., and none. The following are averages for gangs: 2.9 per cent., 2.3 per cent., 16.1 per cent., 1 per cent., 9.7 per cent.

As in the case with the clipper cutting, when the attention of the picker is called to the number of long stems he is leaving and when he knows his fruit is being inspected the number cut incorrectly generally decreases.

CAREFUL HANDLING.

The third point in connection with good picking has to do with careful handling. There is nothing in connection with the citrus business of Florida that impresses a person accustomed to handling different fruits than the roughness with which the oranges are treated. To see the fruit dropped several feet into

the picking bag or basket as the laborer holds the branches with his left hand and clips the fruit with his right, starting it toward the mouth of the basket at a lively speed with his clipper, one would think an imperishable product was being handled instead of a very delicate living fruit. When the picking basket is full, the fruit takes another severe fall into the field crate, and the usual method of locating the gang in the orchard is to listen a moment for the rattle of the oranges in the box. I need not call your attention to all the places in harvesting and packing the crop where rough handling is practiced. If anyone doubts the statement that a large percentage of the fruit falls somewhere at least 18 or 20 inches, a trip with this in mind through his own grove and packing house will probably satisfy him about the matter. At least such a trip through his neighbor's grove will convince him. On his journey let him stop for a moment at the side of the hopper, one of those real large ones, holding fifty boxes or more, and watch the results. Let him place his hand on one of the fruit, and allow the other oranges to hit against it. Just then have him forget that he is watching oranges and imagine that they are apples or perhaps Georgia peaches. I wonder how successful a shipper of such fruits would be if the handling was as rough as that to which the oranges are subjected. Yet the experiments last year indicated that with oranges dropped once 18 inches one out of every five would rot within a short time. This year the skin of the fruit seemed rather thicker and tougher and but ten per cent. rotted. But in test after test where the oranges were dropped 18 inches decay developed where it did not where the fruit was carefully

handled. Charts II and III show the amount of decay in two individual experiments made this past season, where the fruit was held packed in the houses.

CHART II.

Sound, carefully handled.....	1.1 per cent.
Dropped 18 inches.....	10.2 per cent.
Commercial packed.....	16.5 per cent.
Through machinery.....	18.4 per cent.
Mechanically injured.....	25.3 per cent.

CHART III.

Sound, carefully handled.....	1.4 per cent.
Dropped 18 inches.....	9.2 per cent.
Commercial packed.....	19.8 per cent.
Through Machinery.....	11.9 per cent.
Mechanically injured.....	30.0 per cent.

The sound carefully handled lots were picked under our personal supervision and the fruit was not dropped in any way. It was drawn to the packing houses usually on spring wagons, and packed without any machine handling. The dropped fruit was handled in identically the same manner, except that just before packing each orange was dropped separately 18 inches on to the floor of the packing house or into the empty field crate. The series indicated by the words "through machinery" were handled in the grove as the carefully handled lots, but before packing the oranges were poured into the empty hoppers and were then graded and sized in the usual manner, and generally by the labor in the packing house. In all cases, the hoppers and bins were empty so the maximum amount of injury from the machinery was obtained. For this reason it was not uncommon for our experiments to show greater decay in the fruit carefully picked but run through the empty machinery than we secured in the regular commercial pack which had been picked and packed without any attention on our

part. The boxes that made up the "Commercial Pack" were selected after they had been packed and were taken from the fruit coming from the same orchard in which we had obtained the other experiment boxes. The "Mechanically Injured" lots were those in which each orange showed some abrasion. Clipper cuts, box injuries, finger nail scratches and stem punctures were the most common.

Chart IV gives the summary of the decay for all of the experiments that were made this past season, with the fruit held two weeks in the packing houses.

CHART IV.

Summary—Packing House Experiments.

Sound, carefully handled.....	2.1 per cent.
Dropped 18 inches.....	10.0 per cent.
Commercial packed.....	18.2 per cent.
Through machinery.....	20.3 per cent.
Mechanically injured.....	35.4 per cent.

MARKET STORAGE TESTS.

Aside from the experiments, where the fruit has been held in the packing house, about fifteen shipping experiments have been made. These lots have gone by express, freight, and water and have been shipped to Washington. The average length of time in transit has been about 7 days. Upon arrival the fruit was examined and the percentage of decay noted. The fruit was then repacked and held in a common storage room and re-examined at the end of one week and again at the end of two weeks. At that time most of the lots were discarded, yet some boxes of carefully handled fruit were held for some time longer.

The results of these shipments showed that all the lots except the injured fruit arrived at market in a fair condition. Chart V gives the data in detail.

CHART V.

Summary—Market Storage Tests.

	Time of Inspection		
	On arrival.	After 1 week.	After 2 weeks.
Sound, carefully handled	0.4	1.9	4.5
Dropped 18 inches.....	2.3	6.0	10.9
Through machinery.....	1.1	5.4	12.4
Commercial pack.....	3.9	10.6	18.1
Mechanically injured....	20.2	38.0	52.4

The boxes from which the injured fruit has been removed, although the oranges may have been dropped just previous to packing arrived in reasonably good condition. The trip was sufficiently short so that the bruised fruit apparently did not have time to decay and it reached the destination with but a slight amount of loss in excess of the carefully handled boxes. The commercial pack having some injured oranges showed more waste, yet not arriving in a bad condition. The injured boxes averaged 20 per cent. rotten.

At the end of the first week the decay in the carefully handled lots has but slightly increased while that of the bruised fruit jumps up to over 5 or 6 per cent. The commercial pack has reached the high figure of over 10 per cent. The injured fruit shows 38 per cent loss. At the end of the second week the carefully handled series remain still practically sound. All other lots show heavy losses. The commercial pack at that time had nearly one-fifth waste while over one-half of the injured fruit has decayed.

Among the results shown by this chart there is a confirmation of the belief held by the fruit trade in general that it is not a safe thing to handle Florida oranges for even if there is but little decay on arrival, the fruit will not hold sufficiently long for the retailer to sell his stock.

There is probably no other one thing that has more to do with low prices or small demand for Florida fruit at any time than this. The quality of the fruit is such, and the texture and general appearance so good, that there should be a healthy demand for your fruit throughout the season. But as long as the buyer must figure on losing perhaps one-quarter or even one-half of a box by decay, if it is necessary for him to hold it some days, he cannot afford to handle such fruit if there is on the market a brand which he is sure will hold an equally long time with but a slight amount of waste. The sound, carefully handled lots shipped this season answer all his requirements. Is it possible then, to handle your fruit in any better way than is being done at present? Chart VI gives the results of some educational work done among the pickers.

CHART VI.

	Clipper cut.	Total injury and long stems.
Before inspection work.		
December 4	7.4	18.0
December 6	5.6	22.0
After inspection work.		
December 17	2.3	6.0
December 27	1.0	4.0

The first half of the chart gives the percentages of clipper-cuts in one gang at four different inspections, the first two at the time our Department representative began his work. The last inspections show what successful results he obtained. Within a month the average amount of clipper cutting was reduced to 1 per cent., a very fine record. The last part of the chart gives results on the total injuries made in the picking and in addition the number of long stems left. On the fourth and sixth of December the average was 20 per cent; three

weeks later the total was reduced to 4 per cent. This large reduction was made by a little quiet educational work by showing the different pickers where they were doing bad work, and by telling them of the damage this kind of work was doing. This particular lot of pickers was on day pay, so it was easier to work with them than it was with pickers paid by the box. Notwithstanding the better work done, the quantity picked remained about the same and was perfectly satisfactory to the owners. This was in a community where I had been told less than a year before that it was entirely out of the question to pay by the day. Decided improvement may be made, however, with men working by the box. One crowd under a good foreman after some help by us was averaging only about 2 per cent. injury at several inspections.

Those who think it is impossible to handle the fruit with care should visit a large peach ranch in Georgia, where under one general foreman and with colored help, ten cars and more of peaches are shipped in one day, and the fruit is so delicate that a heavy pressure by the finger in picking damages the carrying quality.

The outlook, then, is hopeful. Decay—at least damaging decay—is not necessary. Fruit, sound and carefully handled has been held in the packing houses two weeks with but slight decay. Other lots have been shipped and arrived on the market with almost no loss and have stood the market holding test remarkably well. On the other hand roughly handled and injured fruit should not be expected to keep, and it does not. The methods of harvesting and packing at present in operation are extremely rough and should be expected to produce a poor-

carrying product. Experiments show that this is true. It is not impracticable on the other hand to change these methods sufficiently so that a great improvement in keeping quality may be expected.

DISCUSSION.

Mr. Skinner—I note in your paper you speak of the oranges going through machinery. To what do you refer?

Mr. Tenny—All the machinery found in the average packing house: the hopper, the elevator (if there is one), the sizer and into the bins.

Mr. McClung—How long after the fruit was picked before the dropping of it was done?

Mr. Tenny—We tried it at various times. As a usual thing, within twenty-four hours; almost certainly within thirty-six hours after picking.

Mr. McClung—And you found the same results after the fruit was wilted a little as when perfectly fresh?

Mr. Tenny—Very much the same. The majority of the dropping that causes damage in the commercial handling is done at the time of picking, hence most of our experiments were made with fruit that was dropped immediately after picking.

Mr. Warner—I think it would be a good thing for Mr. Tenny to give us a lecture next year on the methods of packing and shipping oranges from California, using the stereopticon slides so that we can see for ourselves. I make a motion to that effect; that is, that Mr. Tenny give us an illustrated lecture at our meeting next year showing just how these matters are handled by our California brethren.

Motion seconded, put and carried.