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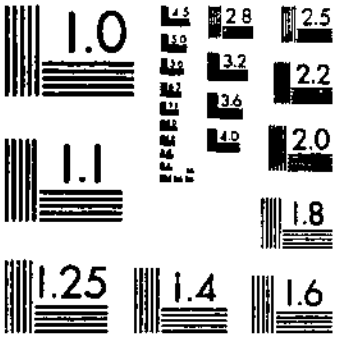

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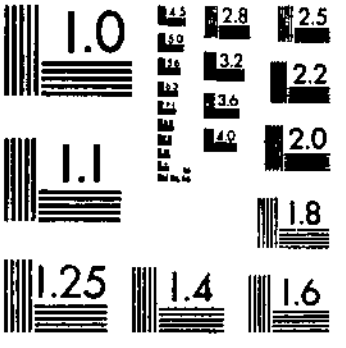

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

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INFLUENCE OF STORAGE TEMPERATURES ON THE REST PERIOD AND DORMANCY OF POTATOES

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INTRODUCTION

Under ordinary storage conditions potatoes will not sprout for some time after being dug. This period of apparent inactivity is commonly known as the rest period. Appleman[1] says, in writing about certain laboratory experiments, this "period varies in different varieties but is quite constant in any given variety. When a few tubers of a lot begin to sprout, it is a matter of a few days until all will sprout."

It is of importance both to the grower and the storage man interested in the keeping of potatoes in a dormant condition either for eating stock or for seed, to know how long he may expect to hold potatoes of a given variety in the desired dormant condition. From a marketing point of view sprouted potatoes are undesirable. They are not desired for food, and the commercial seed dealer does not wish to handle them because the sprouts break off in handling and growers doubt the value of such seed after the first sprouts have broken off. Appleman,[2] however, found that breaking off one or two crops of sprouts has no injurious effects so long as other conditions are kept favorable. When seed stock has reached the sprouting stage the tubers sometimes tend to become soft and shriveled and so less desirable.

There is some confusion as to the meaning of the terms "dormant period" and "rest period." In this discussion, the term "rest period" in potato tubers refers to that period immediately following harvest during which they will not sprout even when kept under

[1] APPLEMAN, C. O. STUDY OF REST PERIOD IN POTATO TUBERS. Md. Agr. Expt. Sta. Bull. 183, pp. 181–226, illus. 1914.
[2] APPLEMAN, C. O. POTATO SPROUTS AS AN INDEX OF SEED VALUE. Md. Agr. Expt. Sta. Bull. 265, pp. 237–258, illus. 1924.

favorable growing conditions. Under the same conditions at the end of this rest period growth activity evidenced by the production of sprouts becomes apparent. On the other hand, if potatoes are held at a temperature too low for sprout growth they will remain in a dormant condition until they break down physiologically. If these potatoes are subjected to conditions favorable for growth at any time after the rest period is over and before this physiological break-down takes place, they will sprout. The rest period of potatoes is therefore determined largely by inherent factors, whereas dormancy is dependent upon both inherent and external factors.

Much is to be found in the literature concerning the many causal factors related to the rest or dormant periods in potatoes or other plants; hence this phase of the subject will not be discussed at length. Müller-Thurgau [3] was one of the early investigators interested in the underlying causes of the rest period of potatoes. He concluded that conditions causing the formation of diastase marked the end of the rest period. He found no diastase in resting potatoes but always found it in sprouting potatoes.

Considerable investigation of artificial methods for shortening the natural rest period for commercial purposes has also been conducted recently, and the results have been published.[4]

EXPERIMENTAL STUDIES

The purpose of the present investigation was to determine the extent to which the range of the controlled storage or holding temperatures most frequently met with in the ordinary commercial handling of potatoes influenced the duration of the rest and dormant periods. The plan did not include the use of chemicals or of wounding practices or any other treatment to break the rest period.

In order to eliminate as far as possible complicating extraneous factors the potatoes used in the tests were grown and stored on the Arlington Experiment Farm at Rosslyn, Va. The varieties studied included the Irish Cobbler, Triumph, Early Rose, Spaulding Rose, Green Mountain, and Russet Rural, and all were from selected seed stock. The work was started in 1925 and continued through 1927. Each year two crops from each variety, consisting of an early and a late planting, were utilized. The early crop was planted in April and the late one in July of each year. Two harvestings were made from each planting. The first consisted of immature stock dug at the first signs of normal yellowing and dying of the tips and edges of the leaves, which is usually considered an indication of approaching maturity, and the second consisted of mature stock dug after the vines were entirely dead and the skins of the tubers well "set" so that they would not readily rub off when handled. The immature tubers were harvested on an average of about 2 weeks in advance of the mature potatoes. The mature tubers of the early crop were usually harvested in July or August, depending on the growing season and the variety, whereas the late mature crop usually was dug

[3] MÜLLER-THURGAU, H. UEBER ZUCKERANHÄUFUNG IN PFLANZENTHEILEN IN FOLGE NIEDERER TEMPERATUR. Landw. Jahrb. 11: [751]–828. 1882.

[4] DENNY, F. E. HASTENING THE SPROUTING OF DORMANT POTATO TUBERS. Amer. Jour. Bot. 13: 118–125. 1926.

——— SECOND REPORT ON THE USE OF CHEMICALS FOR HASTENING THE SPROUTING OF DORMANT POTATO TUBERS. Amer. Jour. Bot. 13: 386–396. 1926.

STUART, W., and MILSTEAD, E. H. BREAKING THE REST PERIOD OF THE POTATO. Proc. 18th Annual Meeting Potato Assoc. of Amer., p. 20–30. 1931.

in early November. Thus there were four lots each year consisting of an immature and a mature crop from both early and late plantings of each of the six varieties.

The potatoes were graded by hand 3 to 4 days after digging, and a selection of nearly uniform medium-sized tubers was made, these being divided into sublots of about a bushel each for storage. The storage temperatures were held constantly at 36°, 40°, 50°, 60°, and 70° F., with relative humidities of 85 to 90 percent. The lots were put in storage within 3 to 4 days after being dug. Every week or two, samples of 10 tubers from each lot of potatoes held at each temperature were selected at random and transferred in 4-quart veneer baskets to a room (hereafter referred to as the sprouting room) held at a constant temperature of 70° with a relative humidity of about 90 percent. Preliminary tests comparing potatoes held as described in the sprouting room, with those covered with moss and wet sand, showed no difference in time for the appearance of sprouts. At weekly intervals after these samples had been placed in the sprouting room a count was made of the tubers showing definite sprouts. The rest period was regarded as completed for any tuber when a single sprout was visible. The selecting of samples from each lot and placing them in the sprouting room was continued until all 10 tubers germinated within 2 weeks. When this was accomplished it was arbitrarily assumed that the rest period of the particular lot of potatoes being sampled was at an end.

REST PERIODS AT DIFFERENT STORAGE TEMPERATURES

The sampling, as already described, started about 2 weeks after the beginning of the storage periods, but in most instances no sprouting was evident after this storage period plus the additional 2 weeks' period in the sprouting room. Since the aim was to determine after what period of storage at a given temperature all the specimens in a sample would germinate within 2 weeks when kept in the sprouting room, regular periodic sampling was not initiated until it seemed that the end of the rest period was approaching.

Table 1 shows the percentage of germination in the successive samplings of all lots held at the different storage temperatures after 2 weeks in the sprouting room.

TABLE 1.—*Percentage of tubers from early and late-planted and mature and immature dug crops, showing sprouts after 2 weeks in the sprouting room (70° F.) following increasing periods in storage at different temperatures*

IRISH COBBLER

When planted	Degree of maturity when dug	Storage temperature	Sprouting after 2 weeks at 70° F. plus number of weeks in storage															
			2	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
		°F.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
Early 1926	Mature	36			0		0			0		0	10	(1)					
Late 1926	do					0		0		0		10		10	90	100			
Early 1927	do									10		100							
Late 1927	do						0		0		0	0	60	60		100			
Late 1926	Immature					0	0	0	0	0	0	0	0	0	20	100			
Late 1927	do				0			0	0	0	0	0	0	0	20	100			
Early 1925	Mature	40		35				70		90		100							
Late 1925	do		0	0		0			0		10		10		100				
Early 1926	do				0		0			10	100								
Late 1926	do					0	0	0	0	0	0	0	10	10	100				
Early 1927	do								0	0	0	100							
Late 1927	do																		
Early 1925	Immature		0	0		0		40		40				60		100			
Late 1925	do		0	0				0		0			0		0		100		
Late 1926	do					0		0		0		0		0	10	50	70	100	
Late 1927	do				0			0		0		0		0	80	100			
Early 1925	Mature	50		50				86		100									
Late 1925	do		0	0		10			60		90		100						
Early 1926	do				0		0			30	60	100							
Late 1926	do					0		0		0	0	0	90	100					
Early 1927	do							0	0	70		90	100						
Late 1927	do						0		0	20	30	30	90	100					
Early 1925	Immature		0	0		0		30		70				100					
Late 1925	do		0	0				0		10			50		100				
Late 1926	do					0		0		0		0		0	10	50	70	100	
Late 1927	do				0			0		0	10	20		50	80	80	100		
Early 1925	Mature	60		25				60		100									
Late 1925	do			0					100										
Early 1926	do				0		0			50	80	80	100						
Late 1926	do					0		10	40	60	100								
Early 1927	do				0	0	0	100											
Late 1927	do						60	80	100										
Early 1925	Immature		0	0		0		40		50				100					
Late 1925	do		0	0				0		0			75	100					
Late 1926	do					0		0		0		0	40	40	100				
Late 1927	do				0			10		80	100								

TRIUMPH

Early 1926	Mature	36				0		0			60	30	0	10	(1)				
Late 1926	do						0	0	20	0	10	30	30	90	100				
Early 1927	do						0	0	20	30	90	100							
Late 1927	do										10	20		100					
Late 1926	Immature						0		0	0	10	20	70	20	(1)				
Late 1927	do					0			0	0	0	0	10	10	100				
Early 1925	Mature	40		20					50		100								
Late 1925	do		0	0			0			0		0		10		100			
Early 1926	do					0		0			10	90	100						
Late 1926	do						0		0	10	10	10	10	90	90	100			
Early 1927	do								0	0	70	100							
Late 1927	do								0	0	0	10	20		50	100			
Early 1925	Immature		0	0		10			50		80				90	100			
Late 1925	do		0	0					0		0		0			0		0	
Late 1926	do					0			0		0		0		0	0	0	10	100
Late 1927	do								0		0	0	10		10	20	100		
Early 1925	Mature	50		70					70		100								
Late 1925	do		0	0		0				0		50		100					
Early 1926	do				0		0	0			40	80	100						
Late 1926	do					0	0	20	20		30	90	100						
Early 1927	do					0	0	30	50		100								
Late 1927	do						0	0	10		100								
Early 1925	Immature		0	0		0		40			80				100				
Late 1925	do		0	0				0			0		0			10		60	100
Late 1926	do			0		0		0			0	0	10	90	100				
Late 1927	do				0			0			90	100							
Early 1925	Mature	60		90				90			100								
Late 1925	do		0	0		0			100										
Early 1926	do				0		0	80		90	60	80	100						
Late 1926	do					0	0	100			100								
Early 1927	do						90	80	100										
Late 1927	do							40			70				100				
Early 1925	Immature		0	0		0		0			0			25	100				
Late 1925	do		0	0		0		0			0	10	40	100					
Late 1926	do				0			60			60	100							
Late 1927	do																		

[1] Tubers were injured by this storage temperature in some samples as the storage time was increased.

TABLE 1.—*Percentage of tubers from early and late-planted and mature and immature dug crops, showing sprouts after 2 weeks in the sprouting room (70° F.) following increasing periods in storage at different temperatures*—Continued

EARLY ROSE

When planted	Degree of maturity when dug	Storage temperature	Sprouting after 2 weeks at 70° F. plus number of weeks in storage															
			2	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
		°F.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
Early 1926	Mature	36	0	0	60	90	100												
Late 1926	do		0		0	30	70	80	50		90	100							
Early 1927	do				20	30	30	100											
Late 1927	do				40	60	70	70	60	100									
Late 1926	Immature					0	0	0	0		0	20	70	70		100			
Late 1927	do				0			0	0	0	10	100							
Early 1925	Mature	40	20	80		100													
Late 1925	do		0	0		20			100										
Early 1926	do				30	80	100												
Late 1926	do				0	0	0	80	80		90	100							
Early 1927	do		20		50		90	100											
Late 1927	do				40	20	50	90	90	90	100								
Early 1925	Immature		0	0		25		50		70		100							
Late 1925	do		0	0				0		0			10		90	100			
Late 1926	do					0		0		0		10	30	40		100			
Late 1927	do				0			50		50	60	100							
Early 1925	Mature	50	60	60		100													
Late 1925	do		0	0		50			100										
Early 1926	do				20	90	100												
Late 1926	do				0	90	90	100											
Early 1927	do			20	40		40	100											
Late 1927	do				30	30	60	100											
Early 1925	Immature		0	0		10		70		100									
Late 1925	do		0	0				0		40			50		100				
Late 1926	do					0		0	0	0	70	80	80	90	100				
Late 1927	do				0			50		50	100								
Early 1925	Mature	60	30	50		90	100												
Late 1925	do		0	0		100													
Early 1926	do				90	90	100												
Late 1926	do				100														
Early 1927	do			30	50	60	60	100											
Late 1927	do				100														
Early 1925	Immature		0	0		20		60		90		100							
Late 1925	do							0		90		100							
Late 1926	do						0		0		60	100							
Late 1927	do					0		90	100										

SPAULDING ROSE

Early 1926	Mature	36			20	60	90	100											
Late 1926	do				0	0	20	70	70		70	100							
Early 1927	do		0	10	30	30			100										
Late 1927	do			0	0	30	50	50			80	100							
Late 1926	Immature				0	0	0		0		0		0	30	40	60	100		
Late 1927	do			0			0	0	0	10	10	10	90	100					
Early 1925	Mature	40	10	40	100														
Late 1925	do		0	10	20				100										
Early 1926	do				90	100													
Late 1926	do				0	50	70	80	100										
Early 1927	do				10			10	100										
Late 1927	do				0	20			30	100									
Early 1925	Immature			0				50		70				100					
Late 1925	do			0				0		0			20		40			100	
Late 1926	do					0		0		0		0	20	40	80	90	90	100	
Late 1927	do					0		30			100								
Early 1925	Mature	50	60	60		100													
Late 1925	do		0	0		60			100										
Early 1926	do				100														
Late 1926	do				0	70	100												
Early 1927	do			20	40		40		100										
Late 1927	do				40	70	50	100											
Early 1925	Immature			0				70		80		90		100					
Late 1925	do			0				0		10			25		100				
Late 1926	do						0	0		0	30	40	60	90	90	100			
Late 1927	do				0	0	0	40		80	100								
Early 1925	Mature	60	20	60		100													
Late 1925	do		0	0		75	100												
Early 1926	do				100														
Late 1926	do				0	90	100												
Early 1927	do			0	10	100													
Late 1927	do				100														
Early 1925	Immature			10				60		80		100							
Late 1925	do			0				0		20		75			100				
Late 1926	do					0			10		30		70	100					
Late 1927	do					0	0	80	100										

TABLE 1.—*Percentage of tubers from early and late-planted and mature and immature dug crops, showing sprouts after 2 weeks in the sprouting room (70° F.) following increasing periods in storage at different temperatures*—Continued

GREEN MOUNTAIN

When planted	Degree of maturity when dug	Storage temperature	Sprouting after 2 weeks at 70° F. plus number of weeks in storage																
			2	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
		° F.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
Early 1926	Mature				0	40	40	50	70		80	80	100						
Late 1926	do				0	0	0	0	0		10	0	90	100					
Early 1927	do	36					0	0	0	80	80	100							
Late 1927	do				0		0		0		0	0	50	50	100				
Late 1926	Immature					0		0		0		0		0	10		10		100
Late 1927	do					0		0		0		0		30		60	100		
Early 1925	Mature		0		25	0		80		100									
Late 1925	do									0		0	0						
Early 1926	do				20	20	30	70	80		90	100							
Late 1926	do				0	0	10	30	40	50	70	80	100						
Early 1927	do	40				0	0	0	40	70	80	100							
Late 1927	do				0	0	0	0	0	0	0	40	40	100					
Early 1925	Immature			0				20		20		100						0	0
Late 1925	do			0				0		0			0						
Late 1926	do					0		0		0		10		10		20	70	90	100
Late 1927	do					0		0		0		0		40		60	80	100	
Early 1925	Mature			10		50	100												
Late 1925	do			0		0		0					60	100					
Early 1926	do				10	40		40	60		100								
Late 1926	do				0	0		10	30	40	50	80	100						
Early 1927	do	50				0	0	0	20	70	70	100							
Late 1927	do					0	0	0	10		90	100							
Early 1925	Immature			0				30		30				50		100			
Late 1925	do			0				0		0			0		50		60	100	
Late 1926	do			0		0		0		0			10		10	20		90	100
Late 1927	do							0		0			0			90	100		
Early 1925	Mature																		
Late 1925	do						0		0		25		80		100				
Early 1926	do				30	50	70	70	90		100								
Late 1926	do		0	0	0	0	20	20	30	50	90	90	100						
Early 1927	do	60				0	0	0	30	100									
Late 1927	do					0	0	20		90	100								
Early 1925	Immature			40				20		30				100					
Late 1925	do							0		0		0	10	0	50	100			
Late 1926	do												10	10		40	90	100	
Late 1927	do											10	20				100		

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RUSSET RURAL

Early 1926	Mature				0	0	40		60		80	100							
Late 1926	do				0	0	0	10	0	20	100								
Early 1927	do			36		0	0	0	10	50		100							
Late 1927	do						0	0	20			30	100						
Late 1926	Immature											10	10	20	20	20		90	100
Late 1927	do																		
Early 1925	Mature		0	65	100														
Late 1925	do				0				0		40					100			
Early 1926	do			0	0	20	30	40			100								
Late 1926	do			0		0		0			60	60	100						
Early 1927	do					0	0	0	0			100							
Late 1927	do	40		0		0		0			0	10	80	100					
Early 1925	Immature						80		80					100					
Late 1925	do						10		10				50		60		75	100	
Late 1926	do						0		0				0		30	60	60	100	
Late 1927	do																		
Early 1925	Mature	0	0		90	100													
Late 1925	do	0	0			0		10			50		100						
Early 1926	do			0		30	30	30			90		100						
Late 1926	do			0		0	0			40	100								
Early 1927	do					0	0	0	0										
Late 1927	do	50					0	0	0	0	0	60	80	100					
Early 1925	Immature						30		50		90			100					
Late 1925	do						0		0				25		100				
Late 1926	do										0		0		30	100			
Late 1927	do																		
Early 1925	Mature	0	25		60		100												
Late 1925	do		0		0				50		100								
Early 1926	do			0	0	20	40	60			100								
Late 1926	do			0	0	0	0	50	80	100									
Early 1927	do						0	0	0							100			
Late 1927	do	60						0	0	0	80	100							
Early 1925	Immature			0		0		100											
Late 1925	do								0						40	100			
Late 1926	do													0	40			100	
Late 1927	do																		

The data are condensed and summarized in table 2 so as to show the average time that elapsed before 100 percent germination in 2 weeks in the sprouting room was produced in successive samplings of mature and immature potatoes which had been held previously at temperatures ranging from 36° to 60° F. The rest periods of potatoes held continuously at 70° are shown for comparison. In the case of the Irish Cobbler and Triumph varieties the data are incomplete because of injury [5] resulting from immediate storing of newly harvested potatoes at a temperature of 36°. Many tubers became so badly injured at this temperature that they were discarded. Those transferred from the 36° room were selected for freedom from apparent cold injury; those from the rooms held at other temperatures were taken at random.

During the first 2 years of this work lots of potatoes were similarly stored at 32°, but low-temperature injury showing itself in the killing of the eyes and other symptoms rendered the results useless so far as this study is concerned.

TABLE 2.—*Average length of rest periods of potatoes held at various storage temperatures, as indicated by the time required for 100 percent sprouting to occur after they had been held 2 weeks in the sprouting room (70° F.); also the rest period of potatoes held continuously at 70°*

Variety	Crop	Maturity of crop when dug	Rest period after storage at temperature of—				Rest period when held continuously at 70° F.[1]
			36° F.	40° F.	50° F.	60° F.	
			Weeks	*Weeks*	*Weeks*	*Weeks*	*Weeks*
Irish Cobbler	Early	Mature	[2] 12	11.7	11.7	10.3	9.3
	Late	do	16	15.0	13.7	9.7	8.0
	Early	Immature		16.0	14.0	14.0	12.0
	Late	do	16.0	17.0	16.7	13.3	10.7
Triumph	Early	Mature	[2] 11.0	11.0	10.7	10.0	10.0
	Late	do	13.5	15.0	11.7	9.3	9.0
	Early	Immature	(3)	15.0	14.0	14.0	10.0
	Late	do	14.0	17.0	14.3	13.0	13.5
Early Rose	Early	Mature	7.5	7.0	7.0	7.3	6.0
	Late	do	11.0	10.7	8.3	5.3	6.7
	Early	Immature		12.0	10.0	12.0	10.0
	Late	do	14.0	14.7	13.7	12.7	10.7
Spaulding Rose	Early	Mature	8.5	6.7	6.7	5.7	4.3
	Late	do	12.0	9.3	8.0	6.3	6.0
	Early	Immature		14.0	14.0	12.0	8.0
	Late	do	16.5	15.7	14.0	12.7	12.3
Green Mountain	Early	Mature	12.5	11.3	10.0	10.5	8.0
	Late	do	14.5	13.5	14.0	13.0	8.5
	Early	Immature		12.0	16.0	14.0	10.0
	Late	do	18.0	18.5	18.5	17.0	11.7
Russet Rural	Early	Mature	11.5	9.7	10.0	11.0	9.0
	Late	do	12.0	14.0	12.7	11.7	10.0
	Early	Immature		14.0	14.0	9.0	10.0
	Late	do	18.0	18.0	15.5	17.0	15.7

[1] The data presented in this column were obtained from potatoes held continuously at 70° F., with 2 weeks deducted from the time of sprouting in order to present the results on a par with those of potatoes held at the other temperatures.

[2] 1926-crop tubers injured by this storage temperature.

A point of interest brought out in table 2 is the tendency in most instances for potatoes of the early crop, which matures and is har-

[5] This does not refer to freezing injury, as freezing of potato tissue will not take place at 32° F. or above. For a more complete discussion of low-temperature injury see PEACOCK, W. M., and WRIGHT, R. C., LOW TEMPERATURE INJURY TO POTATOES WHEN STORED SHORTLY AFTER HARVEST. Potato Assoc. of America, 13th ann. meeting, Dec. 28–29, 1926. Proceedings pp. 99–101. WRIGHT, R. C., PEACOCK, W. M., THE STORAGE OF POTATOES IMMEDIATELY AFTER HARVEST. Potato Assoc. of America, 14th ann meeting, Dec. 28–30, 1927. Proceedings pp. 126–130.

vested during the heat of midsummer, to have a shorter rest period than those from the same lot of seed but planted later and matured and harvested in the fall. An exception to this generalization is seen in the instances of Irish Cobbler and Triumph varieties from storage temperatures of 60° and 70° F. where the opposite is shown. Another point of importance is the fact that the rest period of mature potatoes was approximately 1 to 8 weeks shorter than that of immature potatoes.

On account of the dissimilar results obtained from the different varieties and from the early and late crops it is obvious that these must be considered separately in studying the relative influence of the various storage temperatures upon the rest period. It can be said safely, however, that there is a general tendency in all crops toward a shortening of the rest period as the storage temperature increases.

The rest period of the early mature crops of all varieties proved to be influenced less by the different storage temperatures than were the late mature crops, while the early mature crops of the Early Rose and Russet Rural varieties were apparently less affected than were the other varieties. The average rest period of the mature potatoes of the late-planted crops of the Irish Cobbler, Triumph, Early Rose, and Spaulding Rose varieties was 5.5 weeks or 42 percent shorter when stored at 60° F. than when stored at 36° F.; with the Green Mountain and Russet Rural varieties the difference was rather insignificant.

At 40° F., the usual commercial storage temperature, the shortest rest period of the late mature potatoes, which represents the crop usually stored, occurred with the Spaulding Rose variety, which averaged 9.3 weeks for the 3 years. Next in order were the Early Rose, 10.7 weeks; Green Mountain, 13.5 weeks; Russet Rural, 14 weeks; and Irish Cobbler and Triumph varieties, 15 weeks each. In the same test the varieties of the early mature crops arranged in the order of their rest periods were Spaulding Rose, 6.7 weeks; Early Rose, 7 weeks; Russet Rural, 9.7 weeks; Triumph, 11 weeks; Green Mountain, 11.3 weeks; and Irish Cobbler, 11.7 weeks. The rest periods of the immature early and late crops of all varieties held at this temperature averaged slightly over 4 weeks longer than those of the mature potatoes. These data support the results reported by Rosa,[6] who stored both mature and immature lots of the White Rose, Idaho Rural, and Irish Cobbler varieties for an average of 31 days at 73.4° and 33.8° F., after which they were cut into seed pieces and planted in soil. Sprouts from the mature seed potatoes appeared above the ground before those from the immature ones.

DORMANCY AT DIFFERENT STORAGE TEMPERATURES

While the data were being taken on the sprouting of potatoes transferred to the sprouting room, records were also made of the sprouting as it occurred under continuous storage at the various temperatures. The lowest temperature at which such sprouting was noted was 40° F. Records were kept of potatoes stored at 40°, 50°, 60°, and 70°, and the time when all of the tubers of each lot had

[6] ROSA, J. T. RELATION OF TUBER MATURITY AND OF STORAGE FACTORS TO POTATO DORMANCY. Hilgardia 3: 99-124, illus. 1928.

sprouted at these temperatures is given in table 3. No consistent general difference was observed between the early and late mature crops, but in the immature crops those planted late apparently required a somewhat longer period to sprout than did those planted early. Also, most of the immature tubers when stored required a somewhat longer period to sprout than did the mature ones.

TABLE 3.—*The average dormant period (time when 100 percent show sprouts) of potatoes kept continuously at various storage temperatures*

Variety	Crop	Maturity when dug	Number of weeks held at—			
			40° F.	50° F.	60° F.	70° F.
Irish Cobbler	Early	Mature	25.0	18.5	10.3	11.3
	Late	do	24.0	19.5	12.7	10.0
	Early	Immature		16.0	14.0	14.0
	Late	do	26.0	20.0	17.7	12.7
Triumph	Early	Mature		18.5	15.5	12.0
	Late	do	23.0	19.0	11.7	11.0
	Early	Immature			14.0	12.0
	Late	do	26.0	18.5	15.7	15.5
Early Rose	Early	Mature	18.0	14.5	11.5	8.0
	Late	do	15.0	13.5	11.0	8.7
	Early	Immature		16.0	12.0	12.0
	Late	do	22.0	16.3	14.7	12.7
Spaulding Rose	Early	Mature	18.0	18.0	12.5	6.3
	Late	do	20.0	14.0	9.0	8.0
	Early	Immature				10.0
	Late	do	21.0	17.5	13.0	14.3
Green Mountain	Early	Mature	25.0	18.0	10.0	10.0
	Late	do	27.5	15.0	14.0	10.5
	Early	Immature				12.0
	Late	do	26.0	20.0	17.5	13.7
Russet Rural	Early	Mature		16.0	13.0	11.0
	Late	do	20.0	15.3	13.3	12.0
	Early	Immature				12.0
	Late	do		18.5	16.5	17.7

As might be expected, the varieties studied showed varying germination responses when held at different storage temperatures. For example, at 40° F. storage the mature tubers of different varieties began germinating in an average of 16.5 weeks in the case of the Early Rose variety, whereas the Spaulding Rose variety required 19 to germinate; Russet Rural, 20; Triumph, 23; Irish Cobbler, 24.5; and Green Mountain, 26 weeks. In general, the dormant period shortened as the storage temperature increased. Averaging all varieties, the dormant period at 70° continuous storage was practically half of that at 40°. The immature potatoes in general remained dormant longer than the mature ones. After sprouting had started at each temperature the higher the storage temperature the more rapid the rate of growth. At 40°, after sprouting was evident, the growth of the sprouts was very slow. Even after 2 months the increase in length of sprouts was almost insignificant.

REST PERIODS IN LOTS TRANSFERRED TO THE SPROUTING ROOM AFTER DIFFERENT STORAGE PERIODS AT VARIOUS TEMPERATURES AND LEFT UNTIL SPROUTING FINALLY OCCURRED

In addition to the data already discussed there accumulated certain data from which it was possible to select instances showing the length of rest periods for potatoes moved to the sprouting room and held beyond the usual 2 weeks' period until sprouting finally occurred, after having been held in storage at 36°, 40°, 50°, and 60° F. for increasing periods of time. This information is of scientific interest as well as of practical value when it is desirable to know how soon potatoes germinate following removal from storage for different periods at various temperatures. These data are assembled in table 4 to show the time required for all of the potatoes in a sample to germinate in the sprouting room after increasingly lengthy periods in storage at different temperatures. It is not possible to present this table in the form of a summary because of the irregular transfer periods of the different lots. In general, the various lots were transferred to the sprouting room after 2 to 5 weeks in storage and at fairly short intervals thereafter.

TABLE 4.—*Time required for 100 percent germination of tubers in sprouting room after various preliminary periods in storage at different temperatures*

IRISH COBBLER

When planted	Degree of maturity when dug	Storage temperature	Average period in sprouting room after being stored for the number of weeks indicated																	
			2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
		° F.	Weeks	Weeks	Weeks	Weeks	Weeks	Weeks	Weeks	Weeks	Weeks	Weeks	Weeks	Weeks	Weeks	Weeks	Weeks	Weeks	Weeks	Weeks
Early 1926	Mature	36													(1)					
Late 1926	do						6	5	5	5	4	3	3		3		2			
Early 1927	do					5	5	5	5	5	5	4	2							
Late 1927	do							5	4	4	5		3	3			2			
Late 1926	Immature						8	7	7	5	5	5	4	4	4	3	2			
Late 1927	do					5			5	5	5	5	4	4	3		2			
Early 1925	Mature	40			6				6		4		2							
Late 1925	do		9		7		5			5		4		4		2				
Early 1926	do					5		6			3	2								
Late 1926	do								5	5	4	4	4		3	2				
Early 1927	do					5	5	6	5	4	4	4	2							
Late 1927	do																			
Early 1925	Immature		12		8		8		6		6				4	3	2			
Late 1925	do		11		9				7		5			5				2		
Late 1926	do						7	7	6	6	5	5	4	4	4	3			2	
Late 1927	do					5			5	5	5	4	3	3		3	2			
Early 1925	Mature	50			6				4		2									
Late 1925	do		9		7					4	4	4		2						
Early 1926	do					5		5			4	3	2							
Late 1926	do							5	5	4	4	3	3	3	2					
Early 1927	do					5	6	6	5	4	4	4	3	2						
Late 1927	do							6	5	4	3	3	3	3	2					
Early 1925	Immature		12		8		8		6		4				2					
Late 1925	do		11		9				7		5			4		2				
Late 1926	do						8		7		6	5	4	4	4	3	3	3	2	
Late 1927	do					6			5	4	3					3		2		
Early 1925	Mature	60			6				4		2									
Late 1925	do		9		7					2										
Early 1926	do							6			4		3	2						
Late 1926	do						6	5	4	4	3	2								
Early 1927	do					5	4	4	2											
Late 1927	do							4	3	2										
Early 1925	Immature		12		8		8		4		4				2					
Late 1925	do		11		9				5		5			4	2					
Late 1926	do						8		7		6	5	4	4	3	2				
Late 1927	do					5			3	4	3	2								

(1) 14

TRIUMPH

Early 1926	Mature	36				5		7			4	4	(1)							
Late 1926	do						6	5	4	4	3	3	3	3	2					
Early 1927	do					4	4	4	4	3	3	2	3	2						
Late 1927	do							4	4	4	4	3								
Late 1926	Immature						7	6	6	6	5	4	4	4	4	(1)				
Late 1927	do					6			5	5	4	3	3	3	2					
Early 1925	Mature	40			4				4		2									
Late 1925	do		9		7		5			5		4		4		2				
Early 1926	do					5		5			4		2							
Late 1926	do						6	5	5	5	4	3	3	3	3	2					
Early 1927	do					4	5	5	4	3	3	2								
Late 1927	do							4	4	4	4	4		3	3	2				
Early 1925	Immature		10		8		6		4		4				4	2				
Late 1925	do		11		9				7		7			6						
Late 1926	do						7	7	6	6		6	5	4	4	4	3		2	
Late 1927	do					5			5	5	5		4		3	3	2			
Early 1925	Mature	50			4				4		2									
Late 1925	do		9		7		5			4		4		2						
Early 1926	do					5		6			3	3	2							
Late 1926	do						6	5	5	5	4	3	2							
Early 1927	do					5	4	4	3	3	2									
Late 1927	do							4	4	3	2									
Early 1925	Immature		10		8		6		4		4				2					
Late 1925	do				11									6				4	2	
Late 1926	do							7		7		6	5	3	2					
Late 1927	do					6			4	4	4	2								
Early 1925	Mature	60			4				4		2									
Late 1925	do		9		7		5			2										
Early 1926	do					5	5				4	3	2							
Late 1926	do						6	4	3	3	2									
Early 1927	do					4	4	4	2											
Late 1927	do							3	3	2										
Early 1925	Immature		10		8		6		4		4				2					
Late 1925	do				11				7		5			5	2					
Late 1926	do							7	7			5	3	2						
Late 1927	do					5			4		3	2								

[1] Tubers injured by the storage temperature.

TABLE 4.—*Time required for 100 percent germination of tubers in sprouting room after various preliminary periods in storage at different temperatures*—Continued

EARLY ROSE

When planted	Degree of maturity when dug	Storage temperature	Average period in sprouting room after being stored for the number of weeks indicated																	
			2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
		°F.	Weeks	Weeks	Weeks	Weeks	Weeks	Weeks	Weeks	Weeks	Weeks	Weeks	Weeks	Weeks	Weeks	Weeks	Weeks	Weeks	Weeks	Weeks
Early 1926	Mature	36				3	3	2												
Late 1926	do							5	4	3		3	2							
Early 1927	do				4	5	4	3	2											
Late 1927	do					5	3	3	3	3	2									
Late 1926	Immature							5		4	4	3		3	3		2			
Late 1927	do					4			4	3	3	3	2							
Early 1925	Mature	40	6		6		2													
Late 1925	do		7		5		5			2										
Early 1926	do					5	4	2												
Late 1926	do						4	4	3	3		3	2							
Early 1927	do				5	5	4	3	2											
Late 1927	do					3	3	4	3		3	2								
Early 1925	Immature		6		6		6		4		4		2							
Late 1925	do		8		6		6		6		5			4			2			
Late 1926	do						6	6	5	4	4	3	3		3		2			
Late 1927	do					4			4	3	3	3	2							
Early 1925	Mature	50	4		4		2													
Late 1925	do		7		5		5			2										
Early 1926	do					4	3	2												
Late 1926	do					3	3	3	2											
Early 1927	do				3	4	4	3	2											
Late 1927	do					4	4	4	2											
Early 1925	Immature		8		8		6		4		2									
Late 1925	do		11		11				7		5			4		2				
Late 1926	do						7	6	5	4	4	3	3	3	3	2				
Late 1927	do					4			4	4	3	2								
Early 1925	Mature	60	8		4		4	2												
Late 1925	do		7		5	3	2													
Early 1926	do					3	3	2												
Late 1926	do					2														
Early 1927	do				5	5	4	3	2											
Late 1927	do					2														
Early 1925	Immature		8		8		6		4		4		2							
Late 1925	do		8		8				7		5		2							
Late 1926	do									5	4	3	2							
Late 1927	do					4			3	2										

SPAULDING ROSE

Early 1926	Mature						5	5	4	2													
Late 1926	do						4	4		4	3			2									
Early 1927	do			5			5	5	3		2												
Late 1927	do	36					5	4	4	3	3	3	3	2				3					
Late 1926	Immature							7	7	6	6	5	6	6					3		3	2	
Late 1927	do						5			4	4	3	3				3	2					
Early 1925	Mature		8		4		2																
Late 1925	do		9		7			5			2												
Early 1926	do						3	2															
Late 1926	do						4	3	3	3	2												
Early 1927	do	40			5		4	4	3		2												
Late 1927	do						3	3	3	3	3	2											
Early 1925	Immature				4					4		4					2						
Late 1925	do		8		8					5		5			4						2		
Late 1926	do							7	7	6	5	5	5				3	3			2		
Late 1927	do						4			4	4		2										
Early 1925	Mature		4		4			2															
Late 1925	do		9		7			5			2												
Early 1926	do						2																
Late 1926	do						3	3	2														
Early 1927	do	50			5		5	4	3		2												
Late 1927	do						5	3	3	2													
Early 1925	Immature				8					6		4					2						
Late 1925	do		14		11					7		5			4			2					
Late 1926	do										7	6	5	5	4				2				
Late 1927	do						5			5	4	3	2										
Early 1925	Mature		4		4			2															
Late 1925	do				7			5	2														
Early 1926	do						2																
Late 1926	do						3	4	2														
Early 1927	do	60			6		5	2															
Late 1927	do						2																
Early 1925	Immature				8					4		4			2								
Late 1925	do		13		11					7		5					4	2					
Late 1926	do							10				9			3		2						
Late 1927	do						4			3	2												

TABLE 4.—*Time required for 100 percent germination of tubers in sprouting room after various preliminary periods in storage at different temperatures*—Continued

GREEN MOUNTAIN

When planted	Degree of maturity when dug	Storage temperature	Average period in sprouting room after being stored for the number of weeks indicated																	
			2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
		°F.	Weeks	Weeks	Weeks	Weeks	Weeks	Weeks	Weeks	Weeks	Weeks	Weeks	Weeks	Weeks	Weeks	Weeks	Weeks	Weeks	Weeks	Weeks
Early 1926	Mature	36				5			4	3		3		2						
Late 1926	do						5		6	4	4	4	3		2					
Early 1927	do				7	5	4	5	6	4	3		2							
Late 1927	do					7	5	6	5	5	4	3	3		3	2				
Late 1926	Immature						8	8	8	6	6	5	5		4	4				2
Late 1927	do					7			6	4	4	4	4	4	3	3		2		
Early 1925	Mature	40	10		8		6				2									
Late 1925	do				7		7			6		4								
Early 1926	do					4			4	3		3	2							
Late 1926	do						5	4	4	4	4	3	3	2						
Early 1927	do				7	5	5	5	5	4	3	3	2							
Late 1927	do					6	5	5	5	4	4	4	3	3	2					
Early 1925	Immature								6		4		2							
Late 1925	do		13		11				7		5			4						
Late 1926	do						7	6	6	6	5	5	5		4	4	3			2
Late 1927	do					6			5	4	4		4		3	3				
Early 1925	Mature	50	10		8		6	2												
Late 1925	do				9		7			6					2					
Early 1926	do					5		4	4	4		2								
Late 1926	do						4	4		4		4	3	2						
Early 1927	do				7	5	5	5	5	4	3		2							
Late 1927	do					7	7	6	5	5		4	2							
Early 1925	Immature								6		6						2			
Late 1925	do		13		11				8										2	
Late 1926	do								7	7		6	6		5	4	3	3		2
Late 1927	do					7			7	7	6	5	5		4	4		2		
Early 1925	Mature	60	10																	
Late 1925	do				9		7			6		4				2				
Early 1926	do					5	4		4	3	3	2								
Late 1926	do						4	4		4	4	3	3	2						
Early 1927	do				7	6	5	5	5	4	2									
Late 1927	do					7	7	6	6	5	5	2								
Early 1925	Immature								6		6				2					
Late 1925	do		13		11				7							2				
Late 1926	do						8		8	8			6		5	4	3	3		2
Late 1927	do					7			8	8	7	6		5	4	3		2		

RUSSET RURAL

Early 1926	Mature						4	5	5	4		3	2						
Late 1926	do						5	5	5	4	3	2							
Early 1927	do					36		6	6	6	5	3	2						
Late 1927	do							6	6	5	4	3	3	2					
Late 1926	Immature						8	7	6	5			5		3	3		3	2
Late 1927	do																		
Early 1925	Mature	6		8			2												
Late 1925	do			7			7			6		4				2			
Early 1926	do				4		4	4	5	4		2							
Late 1926	do							6		5	4		3	2					
Early 1927	do							6	6	5	5		2						
Late 1927	do					40		7	6	6	5	4	3		2				
Early 1925	Immature			8					4		4				2				
Late 1925	do			11					7		5							2	
Late 1926	do						8	7	7	7			5	5		4		2	
Late 1927	do																		
Early 1925	Mature	6		6			6	2											
Late 1925	do			9			7			6		4		2					
Early 1926	do						6	5	5	4	3			2					
Late 1926	do						6		6	5		2							
Early 1927	do							10							2				
Late 1927	do					50		8	7	6	5	4	3	3	2				
Early 1925	Immature			8					4		4				2				
Late 1925	do	13							7		5					2			
Late 1926	do						9		8	8	9	8	7	6		4	2		
Late 1927	do																		
Early 1925	Mature	6		6			6		2										
Late 1925	do			9			7			4		2							
Early 1926	do				5			5	5	4		2							
Late 1926	do						6	6	6	4	3	2							
Early 1927	do					60		10	8	6	6				2				
Late 1927	do							8	7	5	4	4	3	2					
Early 1925	Immature			6					4		2								
Late 1925	do	13							7		5						2		
Late 1926	do											8	7	6	5	4		2	
Late 1927	do																		

It will be noted that the time required for total germination in the sprouting room decreased as the storage period increased. This decrease, however, was not in the same proportion as the increase in the storage period. There was, therefore, an actual increase in the total period considering the time in storage plus that in the sprouting room. This increase, which was more marked at the lower temperatures, continued up to the end of the rest period, or to the time when 100 percent germination had occurred.

SUMMARY

The rest period in potatoes is the period immediately following their harvest during which they will not sprout even if kept under favorable growing conditions.

The dormant period includes the rest period and may extend over such time as potatoes may be kept at temperatures unfavorable for growth without undergoing physiological break-down.

A study was made of the influence of storage temperatures ranging from 36° to 70° F. on the rest period and the dormant period of six varieties of potatoes grown and stored at the Arlington Experiment Farm, Rosslyn, Va.

In this investigation the duration of the rest period at different storage temperatures was determined by storing potatoes at 36°, 40°, 50°, and 60° F. and recording the time they could be stored at each storage temperature before sample lots of 10 tubers each would germinate 100 percent after 2 weeks in a germinating room held at 70° with a high relative humidity.

The duration of the dormant period of potatoes stored at 40°, 50°, 60°, and 70° F. was determined by recording the time when all the tubers of a given lot germinated.

When stored at 40° F. early-planted potatoes, maturing during the heat of the summer, had a 1 to 6 weeks' shorter rest period than those maturing in early November.

A tendency toward a shortening of the rest period as the storage temperature increased was evident.

The average rest period of the late-maturing potatoes of the Irish Cobbler, Triumph, Early Rose, and the Spaulding Rose varieties was 5.5 weeks shorter when they were stored at 60° F. than when they were stored at 36°. With the Green Mountain and Russet Rural varieties the storage temperature had little influence upon the length of the rest period.

At 40° F. storage the rest periods of the late-maturing crops of the different varieties were determined as follows: Spaulding Rose, 9.3 weeks; Early Rose, 10.7 weeks; Green Mountain, 13.5 weeks; Russet Rural, 14 weeks; Irish Cobbler, 15 weeks; and Triumph, 15 weeks.

The rest period of immature potatoes of all varieties averaged between 1 and 8 weeks longer than that of mature potatoes, whereas the latter were dug, on an average, 2 weeks later than the former. This difference, however, appeared to be greater during the early part of the storage period than later. Furthermore, these differences varied from crop to crop, probably because of growing conditions.

The dormant periods at 40° F. storage of the different varieties of mature potatoes, or the time required for all the tubers of a given lot to sprout, was determined as follows: Early Rose, 16.5 weeks; Spaulding

Rose, 19 weeks; Russet Rural, 20 weeks; Triumph, 23 weeks; Irish Cobbler, 24.5 weeks; and Green Mountain, 26 weeks.

Sample lots of potatoes were transferred after increased periods of storage at different temperatures to the sprouting room (70° F.) and were kept there until all the tubers had sprouted. While the holding period before growth occurred in the sprouting room decreased as the storage time increased, the total storage and holding time usually increased until the end of the rest period. The time required in the sprouting room for 100 percent of the potatoes to germinate remained practically constant, in most cases, during the early part of the storage period, though meanwhile the total length of that period at the various temperatures was increasing. Toward the end of the storage period the time required for germination in the sprouting room decreased rapidly.

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