GROWING A POTATO CROP FROM AGED, SPROUTED SEED - DOES IT MAKE A DIFFERENCE

by
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If temperature of seed is not fully controlled towards the end of the storage season, during shipping, or after it arrives at the commercial grower, it can easily result in excessive sprouting. It is well documented in the potato literature that sprouting is a result of the physiological condition, often referred to as physiological age, of seed (review: Toosey, 1964). For instance, comparing two batches of seed of the same chronological age and one of the batches was allowed to sprout by storing it at a higher temperature, than the sprouted batch is physiological older than the non-sprouted batch that was stored at a low temperature.

Physiological Aging

The concept of physiological aging is illustrated in Figure 1. On the top line of the figure the life cycle of the potato is shown: tuber formation in June, maturation and harvest in September, storage durng the winter, planting in April, emergence in May, and completion of the cycle in June when new tubers are formed. If seed is stored at a sufficiently low temperature (i.e. 36-38°F), normally sprouting will not take place till after planting. High storage temperature, however, can cause seed to sprout in December or earlier (Figure 1, second and third line). The sprouting indicates that the seed is in a physiological more advanced stage than the non-sprouted seed at the low storage temperature. Note in Figure 1 that the appearance of the sprouts change as the seed gets older. First an extensive elongation of the sprouts takes place, followed by a development of lateral growth creating branches, and eventually the formation of little tubers on the branches. The sprout characteristics, therefore, give an indication of the physiological age, or development stage, of the seed. The third line in Figure 1 shows a rapidly aging cultivar that has a quicker succession of the different sprout stages compared to a slower aging cultivar, shown on the second line in Figure 1.

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Physiological age and sprouting capacity of seed

Physiological age of potato seed tubers affects the sprouting capacity of seed (Figure 2 and 3). Sprouting capacity is estimated by sprouting seed under standard conditions and expressing the obtained sprout fresh weight as a percentage of the initial tuber fresh weight (modified from Hartmans & Van Loon, 1987). In Figure 2, seed age is portrayed by sprout characteristics. Seed that is very young and still dormant is not able to sprout. When dormancy is broken and the eyes of the seed tubers start to 'open up' (peeping), seed is able to sprout but its sprouting capacity is still hindered to some degree by lingering after-effects of the dormancy. Sprouting capacity is at a maximum when seed is able to fully sprout (several eyes are able to produce sprouts). As seed gets older, sprouting capacity of seed declines and it starts to lose its ability to produce a plant. Sprouting capacity curves for Russet Burbank and Norgold Russet are shown in Figure 3. Norgold is a rapidly aging cultivar that peaks earlier in sprouting capacity compared to Burbank, which is a slowly aging cultivar.

Physiological age and crop performance

Field experiments to evaluate the influence of seed age under different irrigation regimes were conducted at the Othello research station from 1989 to 1991. Seed was initially stored at 36-38°F. Seed that was kept at this temperature to prevent sprouting till a week before planting, when it was warmed by placing it at 56°F, was designated as young seed. Seed moved to 56°F (dark, high humidity) one and a half months before planting, where it was allowed to sprout, was defined as old seed. Sprouts from old seed were removed a week before planting (average sprout length was approximately 8 to 10 inches). Young and old seed tubers were cut and treated with TOPS (seed piece treatment) the day before planting. Planting took place early April in 1989 and late April in 1990 and 1991.

Emergence data for young and old seed of Russet Burbank and Norgold Russet are presented in Table 1. Effect of age on time to 50% emergence was not great. A more important effect was observed on final plant stand in 1989 and 1991, when old seed resulted in a stand reduction of 20-25% and 34%, respectively. Note that in both 1989 and 1991 there was a lower average soil temperature after planting compared to 1990 which delayed emergence. In 1990, at higher soil temperatures, old seed had a high percent stand similar to that of young seed. Additionally, the higher average soil temperatures after planting in 1990 allowed for at least 4 to 7 days faster emergence compared to 1989 and 1991, respectively (Table 1).

Reduced emergence from the old seed was due to seed pieces decaying before sprouts could reach the soil surface. Lange and Rosenstock (1965) studied the wound healing in seed stored over time. They found a declining rate of wound healing and final number of periderm layers as seed aged in storage (Figure 4). The lower wound healing capability of old seed might have been the cause for the increased incidence of seed piece decay.

Characteristics of plants from young and old seed observed in the field are presented in Table 2. Old seed of both Russet Burbank and Norgold Russet produced significantly more stems per plant than young seed. The higher number of stems resulted in slightly more tubers per plant for Russet Burbank and markedly more for Norgold Russet.

Final harvest data for 1990 are shown in Table 3. The aging trial was conducted under two irrigation regimes: a high and low frequency regime with irrigation trigger points of 80% and 65% of field capacity, respectively (Wallace, 1991). Total yield under both irrigation regimes was not affected by seed age. Total number of harvested tubers and tuber size, however, was significantly affected by the physiological age of seed. Old seed resulted in more tubers harvested per acre of a smaller size. Size is expressed in Table 3 and 4 as a '50% yield size', meaning that 50% of the yield is comprised of tubers equal or larger than the listed size (see Wallace, 1991). The significantly smaller size for old seed of Norgold resulted in a higher percentage of undersized tubers (<4 oz), causing % U.S. 1 to decline. Age had no effect on % U.S.1 of Burbank.

The results were different for the harvest in 1989 (Table 4). Age of seed had no effect on either tuber number per acre or tuber size (except Norgold at 65% field capacity). Apparently the higher number of tubers per plant for old seed (Table 2) compensated for the loss in stand. In spite of the stand reduction, no difference was found between young and old seed in total yield. However, reduced stand was most likely the cause of a higher percentage of knobby tubers for old seed of Burbank, which is a cultivar that is sensitive to this particular growth abnormality.

Conclusions

Planting physiologically aged seed that has sprouted in storage and is desprouted and cut just before planting can have the following consequences for your crop:

* Emergence
  - Detrimental effect on plant stand as a result of increased seed piece decay if planted and exposed to unfavorable growth conditions that delay emergence (e.g. low soil temperatures, deep planting, wet conditions).
  - No effect or slight delay in emergence.

* Plant Characteristics
  - More stems and tubers per plant.
  - No effect on time of tuber initiation (data not presented).

* Final Harvest
  - No effect on total yield, if stand loss is limited to a 20-25% reduction.
  - More tubers and smaller in size.
  - Established plant population can have overruling effect on tuber number, size, and quality.

References

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Lange H. & G. Rosenstock, 1965. [Cause relational studies between the aging process in wound compensation of storage organs and nutrient factors]. Phytophath Z. 52:188-201.

Toosey R.D., 1964. The pre-sprouting of seed potatoes: Factors affecting sprout growth and subsequent yield. Part I & II. Field Crop Abstracts 17: 161-168, 239-244.

Wallace J.C., 1991. Yield and market suitability of six potato clones at three harvest dates under varying irrigation and nitrogation regimes. Ph.D. Thesis, Washington State University, Pullman, U.S.A.

Table 1. Effect of seed age on days from planting to 50% emergence and final plant stand.

		days to 50% emergence		
		1989	1990	1991
Burbank	YOUNG	30 a*	26 a	33 b
	OLD	31 a	26 a	35 a
Norgold	YOUNG	33 a	28 a	
	OLD	33 a	28 a	
		percent stand		
		1989	1990	1991
Burbank	YOUNG	94 a	100 a	94 a
	OLD	77 b	99 a	66 b
Norgold	YOUNG	94 a	95 a	
	OLD	82 b	91 a	
Soil Temp. (°F)		53	59	54

*Mean comparison within cultivar and year. Numbers followed by the same letter are not significantly different at the 5% level of significance.

Table 2. Effect of seed age on stem and tuber number per plant.

		stems/plant		
		1989	1990	1991
Burbank	YOUNG	2.2 b*	2.3 b	2.1 b
	OLD	3.2 a	3.4 a	3.3 a
Norgold	YOUNG	4.2 b	2.5 b	
	OLD	5.6 a	3.9 a	
		tubers/plant		
		1989	1990	1991
Burbank	YOUNG	9.8 b	10.1 b	8.8 b
	OLD	11.6 a	11.1 a	9.7 a
Norgold	YOUNG	11.6 b	7.9 b	
	OLD	16.4 a	10.2 a	

*Mean comparison within cultivar and year. Numbers followed by the same letter are not significantly different at the 5% level of significance.

Table 3. Effect of seed age on tuber yield, size, and quality under high and low frequency irrigation; 1990.

		yield cwt/acre	tubers 000/acre	size(oz)[**] 50% yield	US1 percent
Burbank					
80% FC	YOUNG	654 a[*]	169 b	7.4 a	67 a
	OLD	661 a	179 a	7.0 a	64 a
65% FC	YOUNG	581 a	163 b	6.7 a	71 a
	OLD	599 a	178 a	6.1 b	72 a
Norgold					
80% FC	YOUNG	634 a	120 b	11.7 a	87 a
	OLD	618 a	161 a	8.5 b	78 b
65% FC	YOUNG	533 a	106 b	10.9 a	87 a
	OLD	567 a	146 a	8.3 b	81 b

[*]Mean comparison within cultivar and year. Numbers followed by the same letter are not significantly different at the 10% level of significance.
[**]50% of yield in cwt/acre comprised tubers equal or larger than the listed size.

Table 4. Effect of seed age on tuber yield, size, and quality under high and low frequency irrigation; 1989.

		yield cwt/acre	tubers 000/acre	size(oz)[**] 50% yield	knobs percent
Burbank					
80% FC	YOUNG	668 a[*]	158 a	8.0 a	10.2 b
	OLD	627 a	152 a	8.5 a	19.1 a
65% FC	YOUNG	625 a	149 a	7.9 a	11.6 b
	OLD	655 a	156 a	8.9 a	16.8 a
Norgold					
80% FC	YOUNG	658 a	136 a	10.0 a	0.2 a
	OLD	646 a	144 a	9.5 a	0.2 a
65% FC	YOUNG	668 a	144 a	10.0 a	0.5 a
	OLD	647 a	156 a	8.7 b	1.7 a

[*]Mean comparison within cultivar and year. Numbers followed by the same letter are not significantly different at the 10% level of significance.
[**]50% of yield in cwt/acre comprised tubers equal or larger than the listed size.

Figure 1

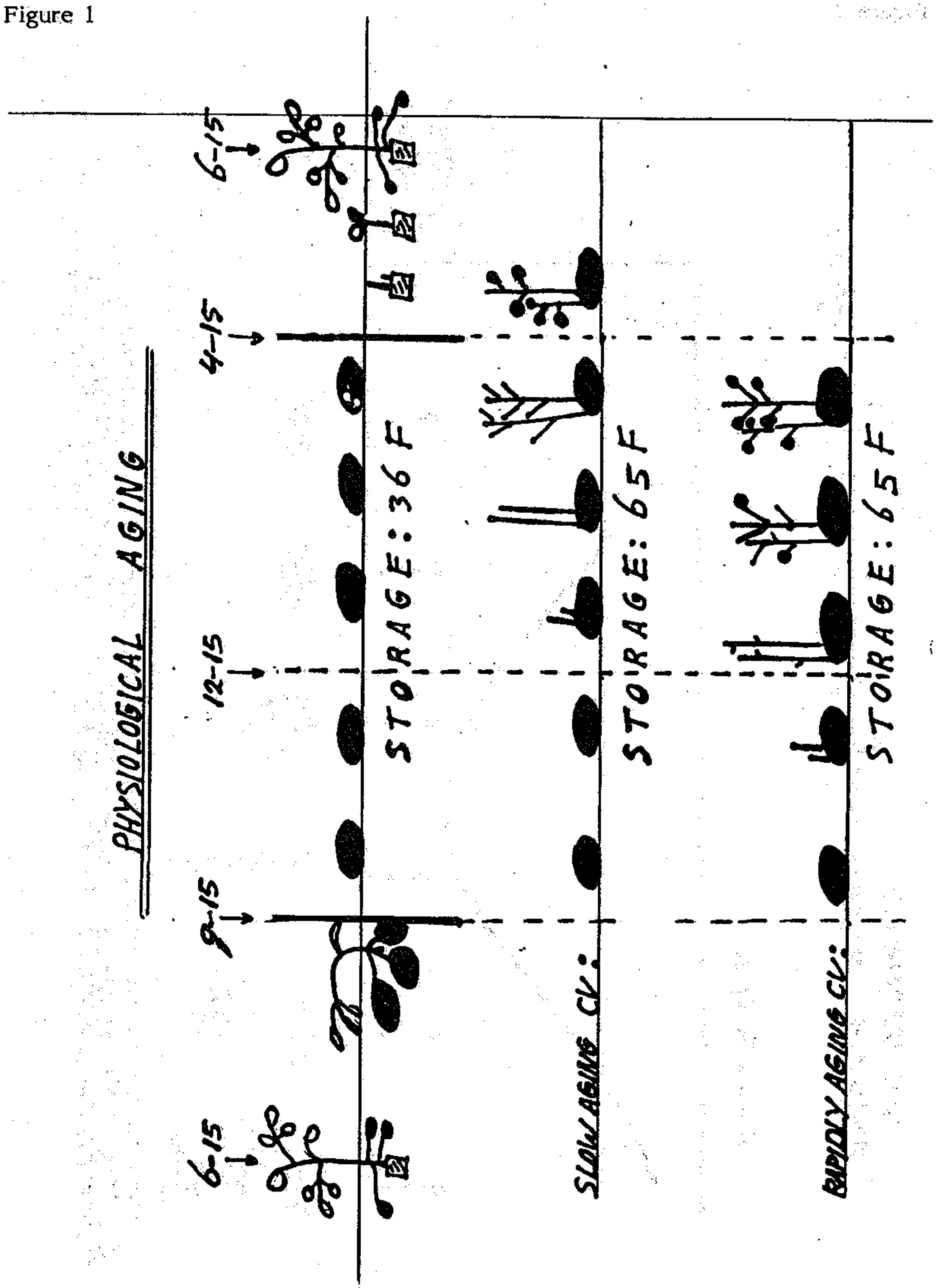

PHYSIOLOGICAL AGING
6-15
9-15
12-15
4-15
6-15
STORAGE: 36 F
SLOW AGING CV:
STORAGE: 65 F
RAPIDLY AGING CV:
STORAGE: 65 F

Figure 2

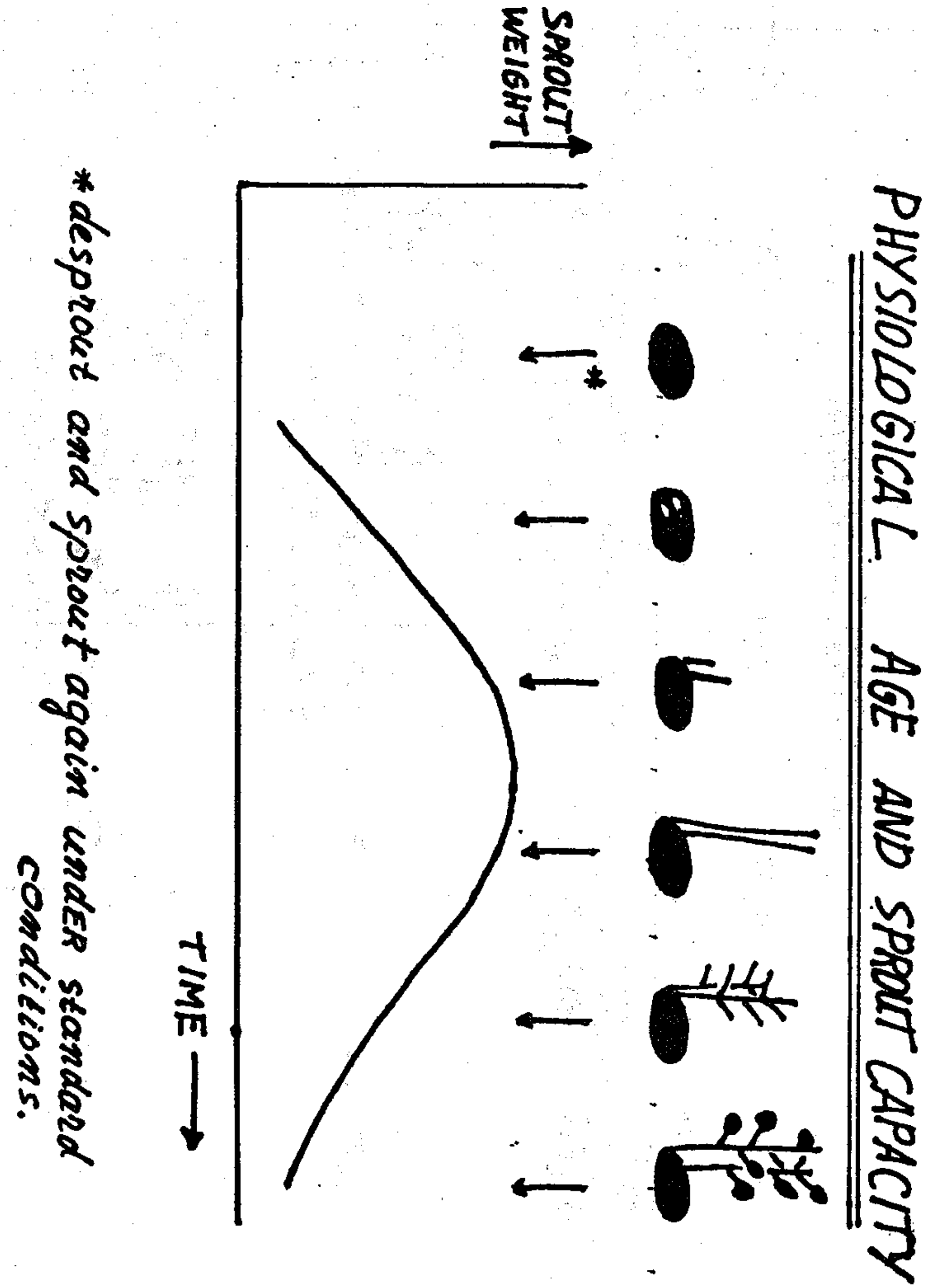

PHYSIOLOGICAL AGE AND SPROUT CAPACITY
SPROUT WEIGHT
TIME
*
*desprout and sprout again under standard conditions.

Figure 3

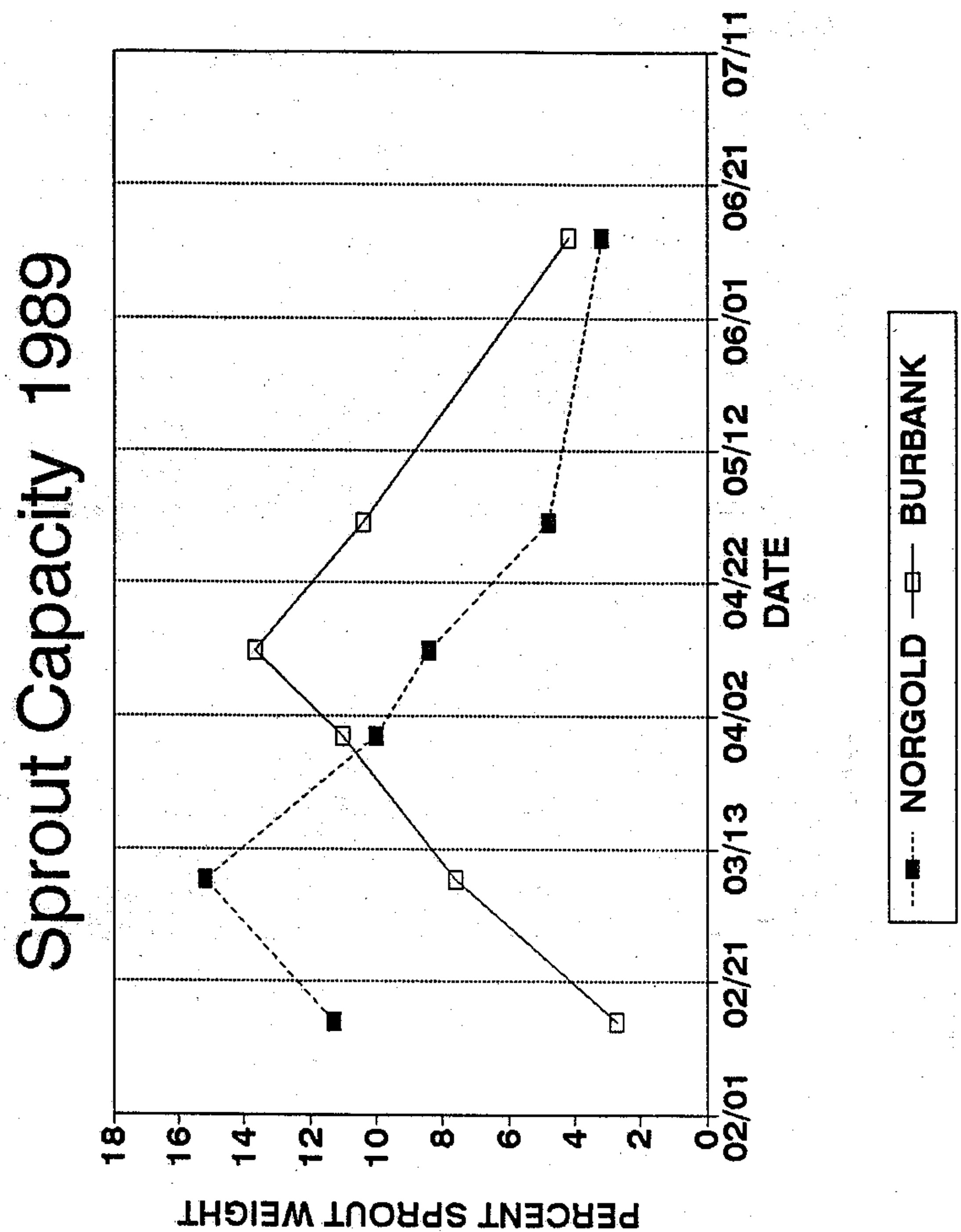
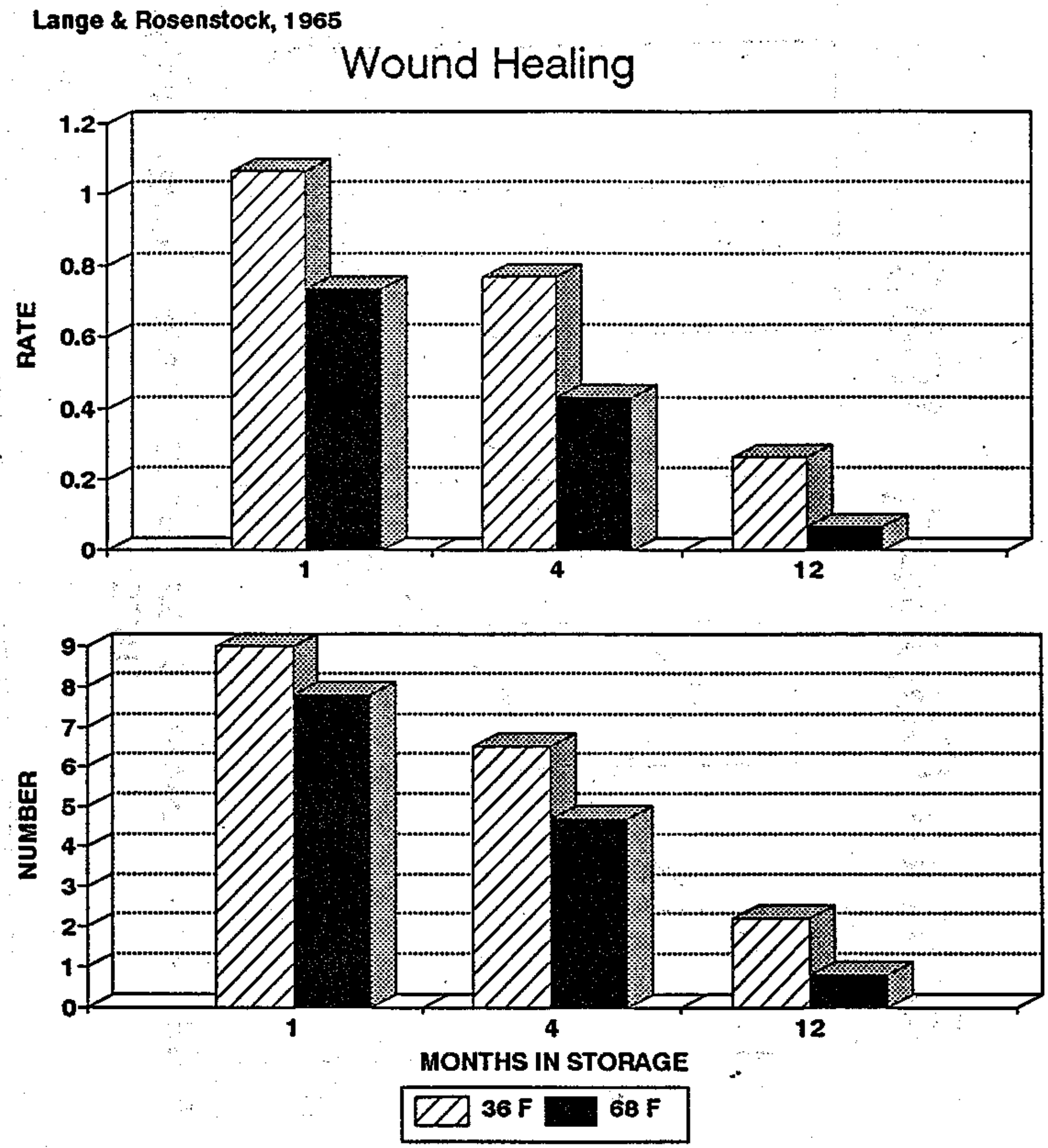

Sprout Capacity 1989
PERCENT SPROUT WEIGHT
0
2
4
6
8
10
12
14
16
18
02/01
02/21
03/13
04/02
04/22
05/12
06/01
06/21
07/11
DATE
NORGOLD
BURBANK

Figure 4


Lange & Rosenstock, 1965
Wound Healing
RATE
1.2
1
0.8
0.6
0.4
0.2
0
1
4
12
NUMBER
9
8
7
6
5
4
3
2
1
0
1
4
12
MONTHS IN STORAGE
36 F
68 F