



ON SEED GERMINATION

Thesis for the Degree of B. S.

Cass B. Laitner

1897

THESIS
ON
SEED GERMINATION.

By Cass B.²Laitner.

THESIS

Thesis on Seed Germination.

This thesis is designed as a rambling sort of research into seed germination. The object is to compare the germination of given samples of seeds in Geneva testers, one kept at 60 degrees and the other at 70; to compare samples taken from same seeds when placed in soil with the same differences in temperature; and to ascertain the value of the Geneva tester as compared with an actual soil test.

The Geneva tester used in these experiments consisted of a sheet-iron pan to hold the water and a number of cotton cloths fastened on each side to wire rods so, the rods being pushed close together, the middle of the cloth would sag and a piece of cloth left free purposely in the centre would hang into the water. The seeds were placed on the cloth and capillary attraction kept them constantly moist.

The earth tests were made in ordinary flats, the soil used being very rich, rather too rich for the purpose. The seeds were planted in rows across the flat and being examined daily each young plant was removed as it made its appearance. These boxes were watered well at the start and kept moist and well weeded. All these testers were kept at even temperatures as much as possible, one Geneva tester and soil test being kept at 60 degrees, the other two at 70 degrees.

The seeds used were samples taken from last season's crop, and old seeds of the same sorts as the new as much as possible, taken mainly from the crop of 1880. The samples contained fifty seeds, all the experiments being duplicated.

<u>15</u>	<u>16</u>	<u>17</u>	<u>18</u>	<u>19</u>	<u>Total at 6th day.</u>	<u>Total at 12th day.</u>	<u>Total</u>
-	-	-	-	-	44	68	70
-	-	-	-	-	40	74	76
2	-	-	-	1	72	90	96
-	-	-	-	-	83	94	94
-	-	1	-	-	74	80	82
-	-	-	1	-	60	70	76
-	-	-	-	-	0	2	2
-	-	-	-	-	92	92	92
-	-	-	-	-	96	96	96
4	-	2	-	1	0	40	64
4	-	3	3	-	0	42	72
-	-	-	-	-	32	100	100
-	-	-	-	-	74	94	96
7	-	4	1	-	0	64	90
1	-	-	-	-	0	70	90
-	-	-	-	-	48	80	88
-	-	-	-	-	60	92	92
1	-	-	-	-	0	4	6
-	-	-	-	-	2	3	10
1	-	-	1	-	0	4	12
-	-	-	-	-	0	6	6
-	-	-	-	-	0	2	2
-	-	1	-	-	0	0	4

TABLE I Continued.

	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>10</u>	<u>11</u>	<u>12</u>	<u>13</u>	<u>14</u>
Sage	-	-	1	-	5	-	-	10	-	-	2	2
"	-	-	-	-	-	-	-	3	-	5	4	-
Sage '90.	-	-	-	-	1	2	-	7	2	-	-	3
"	-	-	-	1	3	4	-	3	1	1	-	1
Cabbage.	-	32	6	10	-	-	-	-	-	-	-	-
"	-	6	19	5	2	1	-	1	1	-	-	-
Cabbage '90.	-	4	17	4	3	1	-	1	5	1	-	-
"	-	6	19	5	2	1	-	1	1	-	-	-
Pepper.	-	-	-	-	-	-	-	1	2	1	1	4
"	-	-	-	-	-	-	-	-	-	3	2	2
Bean.	-	-	42	4	3	-	-	-	-	-	-	-
"	-	-	2	39	5	2	-	-	-	-	-	-
Corn.	3	34	21	-	-	-	-	-	-	-	-	-
"	7	23	15	-	-	-	-	-	-	-	-	-
Watermelon '90.	-	-	-	-	-	-	-	5	1	2	-	9
"	-	-	-	-	-	3	-	2	7	19	1	4
Kohl Rabe '90.	-	2	15	2	3	1	-	1	2	5	1	-
"	-	3	13	1	-	1	-	-	-	-	1	1
Lettuce.	49	-	-	-	1	-	-	-	-	-	-	-
"	47	1	-	-	-	-	-	-	-	-	-	-
Turnip '90.	-	3	21	5	4	5	-	3	1	-	1	-
"	-	1	22	4	4	4	-	3	-	-	-	1
Squash.	-	-	-	-	-	12	-	3	5	5	4	2
"	-	-	-	-	2	16	-	6	5	2	4	3
Pea.	-	1	32	9	1	-	-	-	-	-	-	-
"	-	-	35	10	1	-	-	2	-	-	-	-

<u>15</u>	<u>16</u>	<u>17</u>	<u>18</u>	<u>19</u>	<u>Total at 5th day.</u>	<u>Total at 12th day.</u>	<u>Total.</u>
-	-	1	-	-	2	36	42
1	-	-	-	-	0	26	36
3	-	1	1	-	0	24	40
3	-	2	2	1	2	46	44
-	-	-	-	-	76	96	96
-	-	-	-	-	26	96	96
1	-	-	-	-	50	72	74
-	-	-	-	-	60	70	70
3	-	2	2	-	0	8	32
1	-	3	1	1	0	6	26
-	-	-	-	-	92	96	96
-	-	-	-	-	32	96	96
-	-	-	-	-	36	96	96
-	-	-	-	-	96	96	96
26	-	2	-	-	0	16	90
3	-	1	-	-	0	72	72
-	-	1	-	-	32	96	94
-	-	-	1	-	32	82	42
-	-	-	-	-	32	100	100
-	-	-	-	-	36	96	96
-	-	-	-	-	42	94	92
-	-	1	-	-	54	76	70
4	-	5	-	-	0	62	92
4	-	3	2	1	0	26	36
-	-	-	-	-	96	96	96
-	-	-	-	-	90	96	96

TABLE II. Geneva Test in Warm House.

	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>10</u>	<u>11</u>	<u>12</u>	<u>13</u>	<u>14</u>
Spinach.	-	5	6	4	7	4	-	5	5	3	-	-
"	-	6	4	5	6	3	-	3	5	3	1	-
Radish.	30	6	1	1	1	-	-	-	-	-	-	-
"	44	3	-	-	-	-	-	-	-	1	-	-
Radish '00.	46	3	7	2	1	-	-	-	-	2	-	-
"	30	5	6	4	-	-	-	-	-	-	-	-
Paroniz '00	-	-	-	-	-	-	-	-	-	-	-	1
"	-	-	-	-	-	-	-	-	-	-	1	-
Cucumber.	-	46	1	-	-	-	-	-	-	-	-	-
"	-	43	3	2	-	-	-	-	-	-	-	-
Cucumber '00.	-	-	5	12	7	3	-	8	2	1	-	-
"	-	-	3	11	9	1	-	5	2	1	3	-
Tomato.	-	-	-	42	8	-	-	-	-	-	-	-
"	-	-	-	37	5	4	-	1	-	-	-	-
Tomato '00.	-	-	21	-	13	3	7	-	-	-	-	-
"	-	-	-	19	15	-	-	7	4	2	-	-
Onion.	4	22	12	5	2	-	-	-	-	1	-	-
"	8	13	13	4	3	1	-	-	-	-	-	-
Onion '00	-	-	-	-	1	-	-	-	-	1	-	-
"	-	-	-	-	-	1	-	-	2	-	-	-
Caraway	-	-	-	-	-	-	-	-	-	-	1	-
"	-	-	-	-	-	-	-	-	-	-	-	-
Caraway '00.	-	-	-	1	-	-	-	1	-	-	-	-
"	-	-	-	-	-	1	-	-	-	-	-	-

<u>15</u>	<u>16</u>	<u>17</u>	<u>18</u>	<u>19</u>	<u>20</u>	<u>Total at 6th day.</u>	<u>Total at 12th day.</u>	<u>Total</u>
-	-	-	-	-	-	28	76	76
-	-	-	-	-	-	30	84	80
-	-	-	-	-	-	92	94	94
-	-	-	-	-	-	92	94	94
-	-	-	-	-	-	96	96	96
-	-	-	-	-	-	90	90	90
-	-	-	1	-	-	0	0	4
-	-	-	-	-	-	0	0	3
-	-	-	-	-	-	94	94	94
-	-	-	-	-	-	96	96	96
-	-	-	-	-	-	34	76	76
-	-	-	-	-	-	28	64	70
-	-	-	-	-	-	84	100	100
-	-	-	-	-	-	74	94	94
-	-	-	-	-	-	42	90	90
-	-	-	-	-	-	38	64	64
1	-	-	-	-	-	36	92	94
-	-	-	-	-	-	86	94	94
-	-	-	-	-	-	0	4	4
1	-	-	-	-	-	0	6	3
-	-	1	-	-	-	0	0	4
-	-	-	-	-	-	0	0	0
-	-	1	-	-	-	2	4	6
-	-	-	-	-	-	0	2	2

(In order on opposite page.)

TABLE II Continued.

	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>10</u>	<u>11</u>	<u>12</u>	<u>13</u>	<u>14</u>
Sage	-	-	-	3	14	8	-	3	1	-	-	-
"	-	-	-	1	-	-	-	3	-	-	-	-
Sage '90.	-	-	-	-	-	3	-	5	4	1	2	-
"	-	-	-	1	-	-	-	4	5	-	-	1
Cabbage.	47	1	-	1	-	-	-	-	-	-	-	-
"	48	-	-	-	-	-	-	-	-	-	-	-
Cabbage '90.	13	11	6	5	3	4	-	-	-	-	1	-
"	8	10	12	3	3	-	-	1	-	1	-	2
Pepper	-	-	-	-	-	-	-	11	4	5	3	3
"	-	-	-	-	-	-	-	8	6	5	4	4
Bean	-	-	20	13	2	1	-	1	-	-	-	-
"	-	31	11	4	1	-	-	-	-	-	-	-
Corn.	-	20	19	7	-	-	-	-	-	-	-	-
"	-	18	21	6	1	-	-	1	-	-	-	-
Water Melon '90.	-	2	14	5	1	-	-	10	2	-	-	1
" "	-	-	3	3	13	-	-	1	-	1	2	5
Kohl Rabi '90.	11	18	10	2	1	1	-	1	-	-	-	-
" "	15	13	9	4	3	-	-	1	1	-	-	-
Lettuce.	43	4	1	1	-	-	-	-	-	-	-	-
"	48	-	1	-	-	-	-	-	-	-	-	-
Turnip. '90.	11	14	15	4	1	1	-	2	-	-	-	-
"	15	13	10	5	3	-	-	1	-	-	-	-
Squash.	15	11	4	2	3	5	-	1	2	1	-	1
"	10	16	5	3	1	3	-	3	1	2	1	2
Pea.	-	8	12	19	1	3	-	-	-	-	-	-
"	-	10	9	16	5	-	1	-	-	-	-	-

15	16	17	18	19	20	Total at 6 days.	Total at 12 days.	Total.
-	-	-	-	-	-	6	58	58
-	-	-	-	-	-	14	60	60
1	-	-	-	-	-	0	24	50
-	1	-	-	-	-	2	20	24
-	-	-	-	-	-	98	98	92
-	-	-	-	-	-	90	96	96
-	-	-	-	-	-	70	84	86
-	-	-	-	-	-	66	76	80
4	-	5	3	1	-	0	40	78
5	-	7	1	-	-	0	38	80
-	-	-	-	-	-	84	92	92
-	-	-	-	-	-	92	94	94
-	-	-	-	-	-	92	92	92
-	-	-	-	-	-	80	94	94
-	-	-	-	-	-	32	68	70
2	-	5	1	-	-	12	42	72
-	-	-	-	-	-	92	80	88
-	-	-	-	-	-	82	92	92
-	-	-	-	-	-	98	98	98
-	-	-	-	-	-	98	90	9
-	-	-	-	-	-	88	96	96
-	-	-	-	-	-	86	94	94
-	-	-	-	-	-	64	82	90
-	-	-	-	-	-	68	88	94
-	-	-	-	-	-	78	90	98
-	-	-	-	-	-	70	82	92

TABLE III.

Seeds in Earth at 70 Degrees.

Upper row of figures- earth; lower row- sand.

	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>10</u>	<u>11</u>	<u>12</u>	<u>13</u>	<u>14</u>	<u>15</u>	<u>16</u>
ch.	-	-	-	1 2	-	1 6	2 1	2 0	1 1	1	-	-
	-	-	-	1	-	3 4	2 2	1	-	1	1 0	-
sh.	2	4 6	4 10	1 0	-	-	-	1 0	-	-	0	-
	2	2 3	5 3	2 1	-	1	1	-	1 1	1 1	1 1	-
sh '90.	-	-	5 8	4 3	-	2 3	-	1	1 0	-	-	-
	-	6 10	1 2	2 1	-	3 3	-	1 0	1 0	0	-	-
ber.	-	10 18	3 3	1 0	-	-	-	-	-	-	-	-
	-	-	13 22	0 0	-	1 1	-	-	-	-	-	-
ber '90.	-	-	-	-	-	1 2	1 1	0 4	2 1	1 1	-	-
	-	-	-	-	-	-	-	-	3 1	1 1	1 2	-
to.	-	-	-	-	-	-	-	19 24	1	1	-	-
	-	-	-	-	-	-	-	20 24	-	-	-	-
to '93.	-	-	-	-	-	-	-	-	2	3 21	5 3	-
	-	-	-	-	-	-	-	-	-	3 18	5 3	-

<u>17</u>	<u>18</u>	<u>19</u>	<u>20</u>	<u>21</u>	<u>22</u>	<u>23</u>	<u>24</u>	Total at 6 days.	Total at 12 days.	Total.
-	-	-	-	-	-	-	-	0	14	14
-	-	-	-	-	-	-	-	0	18	22 = 56
-	-	-	-	-	-	-	-	8	10	12
-	-	-	-	-	-	-	-	0	16	18 = 30
-	-	-	-	-	-	-	-	8	20	28
-	-	-	-	-	-	-	-	16	36	38 = 58
-	-	-	-	-	-	-	-	4	18	22
-	-	-	-	-	-	-	-	20	32	38 = 60
-	-	-	-	-	-	-	-	0	22	24
-	-	-	-	-	-	-	-	0	30	30 = 54
-	-	-	-	-	-	-	-	12	26	28
-	-	-	-	-	-	-	-	20	32	38 = 60
-	-	-	-	-	-	-	-	20	28	28
-	-	-	-	-	-	-	-	36	41	41 = 69
-	-	-	-	-	-	-	-	0	30	30
-	-	-	-	-	-	-	-	0	43	43 = 73
-	-	-	-	-	-	-	-	0	4	10
-	-	-	-	-	-	-	-	0	14	18 = 28
-	-	-	-	-	-	-	-	0	0	14
-	-	-	-	-	-	-	-	0	1	10 = 24
-	-	-	-	-	-	-	-	0	39	38
-	-	-	-	-	-	-	-	0	48	49 = 67
-	-	-	-	-	-	-	-	0	40	42
-	-	-	-	-	-	-	-	0	48	48 = 90
-	-	-	-	-	-	-	-	0	0	24
-	-	-	-	-	-	-	-	0	0	27 = 51
-	-	-	-	-	-	-	-	0	0	26
-	-	-	-	-	-	-	-	0	0	44 = 70

(12)

TABLE III Continued.

	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>10</u>	<u>11</u>	<u>12</u>	<u>13</u>	<u>14</u>	<u>15</u>	<u>16</u>
Onion.								6	3	2	0	-
	-	-		-	-	-	-	9	8	3	1	-
"								2	2	2	1	-
	-	-	-	-	-	-	-	7	11	5	2	-
Onion '90.											2	
	-	-	-	-	-	-	-	-	-	-	1	-
Caraway.												
	-	-	-	-	-	-	-	-	-	-	-	-
Sage.									1	0	6	
	-	-	-	-	-	-	-	-	2	2	5	-
"									2	2	2	
	-	-	-	-	-	-	-	-	0	1	1	-
Sage '90.												
	-	-	-	-	-	-	-	-	-	-	-	-
"												
	-	-	-	-	-	-	-	-	-	-	-	-
Cabbage.				3		6	3			1		
	-	-	-	3	-	19	1	-	-	0	-	-
"				3		5	2			1		
	-	-	-	5	-	12	0	-	-	0	-	-
Cabbage '90.						5			2			
	-	-	-	-	-	14	-	-	2	-	-	-
"								1				
	-	-	-	-	-	10	-	3	-	2	-	-
Pepper.												
	-	-	-	-	-	-	-	-	-	-	-	-
"												
	-	-	-	-	-	-	-	-	-	-	-	-
Bean.							1	5	3		2	
	-	-	-	-	-	-	3	3	2	-	0	-
"								5	4	3	2	
	-	-	-	-	-	2	-	3	3	3	0	

<u>17</u>	<u>18</u>	<u>19</u>	<u>20</u>	<u>21</u>	<u>22</u>	<u>23</u>	<u>24</u>	Total at 6 days.	Total at 12 days.	Total.
2		0	-	-	-	-	-	0	12	36
								0	12	42 = 78
1			-	-	-	-	-	0	4	14
								0	14	54 = 68
-	1	-	-	-	1	-	-	0	0	6
								0	0	4 = 10
-	-	-	1	-	-	-	-	0	0	2
								0	0	4 = 6
4								0	0	22
3	-	-	-	-	-	-	-	0	0	24 = 48
3								0	0	16
5	-	-	-	-	-	-	-	0	0	14 = 30
		1				1		0	0	4
3	-	1	-	-	-	0	-	0	0	6 = 10
3			1				1	0	0	8
4	3	-	0	1	1	-	0	0	0	12 = 20
								0	54	32
-	-	-	-	-	-	-	-	0	40	46 = 62
								0	20	22
-	-	-	-	-	-	-	-	0	54	54 = 78
1								0	10	16
-	-	-	-	-	-	-	-	0	20	32 = 38
1								0	2	4
0	-	-	-	-	-	-	-	0	30	40 = 44
	1	3	2	1		1		0	0	16
1	2	4	1	1	-	0	-	0	0	20 = 30
	3	3	1	1			1	0	0	18
1	5	4	1	0	-	-	0	0	0	30 = 38
	1	1						0	12	16
1	0	0	-	-	-	-	-	0	12	16 = 32
								0	10	20
0	1	1	-	-	-	-	-	0	20	30 = 38

TABLE II. Geneva Test in Warm House.

	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>10</u>	<u>11</u>	<u>12</u>	<u>13</u>	<u>14</u>
Spinach.	-	5	6	6	7	4	-	5	5	3	-	-
"	-	6	4	5	6	3	-	3	5	3	1	-
Radish.	30	6	1	1	1	-	-	-	-	-	-	-
"	44	3	-	-	-	-	-	-	-	1	-	-
Radish '00.	16	3	7	2	1	-	-	-	-	2	-	-
"	30	5	6	4	-	-	-	-	-	-	-	-
Parsony '00	-	-	-	-	-	-	-	-	-	-	-	1
"	-	-	-	-	-	-	-	-	-	-	1	-
Cucumber.	-	46	1	-	-	-	-	-	-	-	-	-
"	-	42	3	2	-	-	-	-	-	-	-	-
Cucumber '00.	-	-	5	12	7	3	-	8	2	1	-	-
"	-	-	3	11	9	1	-	5	2	1	3	-
Tomato.	-	-	-	42	8	-	-	-	-	-	-	-
"	-	-	-	37	5	4	-	1	-	-	-	-
Tomato '05.	-	-	21	-	13	3	7	-	-	-	-	-
"	-	-	-	19	15	-	-	7	4	2	-	-
Onion.	4	22	12	5	2	-	-	-	-	1	-	-
"	8	13	13	4	3	1	-	-	-	-	-	-
Onion '00	-	-	-	-	1	-	-	-	-	1	-	-
"	-	-	-	-	-	1	-	-	2	-	-	-
Caraway	-	-	-	-	-	-	-	-	-	-	1	-
"	-	-	-	-	-	-	-	-	-	-	-	-
Caraway '00.	-	-	-	1	-	-	-	1	-	-	-	-
"	-	-	-	-	-	1	-	-	-	-	-	-

<u>15</u>	<u>12</u>	<u>17</u>	<u>12</u>	<u>19</u>	<u>20. Total at 6th day.</u>	<u>Total at 14th day.</u>	<u>Total</u>
-	-	-	-	-	28	76	76
-	-	-	-	-	30	84	80
-	-	-	-	-	92	94	94
-	-	-	-	-	92	94	94
-	-	-	-	-	96	96	96
-	-	-	-	-	90	90	90
-	-	-	1	-	0	0	4
-	-	-	-	-	0	0	2
-	-	-	-	-	94	94	94
-	-	-	-	-	90	90	90
-	-	-	-	-	34	76	76
-	-	-	-	-	28	64	70
-	-	-	-	-	34	100	100
-	-	-	-	-	74	94	94
-	-	-	-	-	42	90	90
-	-	-	-	-	38	74	94
1	-	-	-	-	30	92	94
-	-	-	-	-	90	94	94
-	-	-	-	-	0	4	4
1	-	-	-	-	0	6	8
-	-	1	-	-	0	0	4
-	-	-	-	-	0	0	0
-	-	1	-	-	2	4	6
-	-	-	-	-	0	2	2

(In order on opposite page.)

TABLE II Continued.

	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>10</u>	<u>11</u>	<u>12</u>	<u>13</u>	<u>14</u>
Sage	-	-	-	3	14	8	-	5	1	-	-	-
"	-	-	-	1	-	-	-	5	-	-	-	-
Sage '90.	-	-	-	-	-	8	-	5	4	1	2	-
"	-	-	-	1	-	-	-	4	5	-	-	1
Cabbage.	47	1	-	1	-	-	-	-	-	-	-	-
"	48	-	-	-	-	-	-	-	-	-	-	-
Cabbage '90.	15	11	6	5	3	4	-	-	-	-	1	-
"	8	10	12	3	3	-	-	1	-	1	-	2
Pepper	-	-	-	-	-	-	-	11	4	5	3	3
"	-	-	-	-	-	-	-	8	6	5	4	4
Bean	-	-	20	13	2	1	-	1	-	-	-	-
"	-	31	11	4	1	-	-	-	-	-	-	-
Corn.	-	20	19	7	-	-	-	-	-	-	-	-
"	-	18	21	6	1	-	-	1	-	-	-	-
Water Melon '90.	-	2	14	5	1	-	-	10	2	-	-	1
" "	-	-	3	3	13	-	-	1	-	1	2	5
Kohl Rabi '90.	11	18	10	2	1	1	-	1	-	-	-	-
" "	15	13	9	4	3	-	-	1	1	-	-	-
Lettuce.	43	4	1	1	-	-	-	-	-	-	-	-
"	48	-	1	-	-	-	-	-	-	-	-	-
Turnip. '90.	11	14	15	4	1	1	-	2	-	-	-	-
"	15	13	10	5	3	-	-	1	-	-	-	-
Squash.	15	11	4	2	3	5	-	1	2	1	-	1
"	10	16	5	3	1	3	-	3	1	2	1	2
Pea.	-	8	12	19	1	3	-	-	-	-	-	-
"	-	10	9	16	5	-	1	-	-	-	-	-

15	16	17	18	19	20	Total at 6 days.	Total at 12 days.	Total.
-	-	-	-	-	-	6	58	58
-	-	-	-	-	-	14	60	60
1	-	-	-	-	-	0	24	50
-	1	-	-	-	-	2	20	24
-	-	-	-	-	-	98	98	98
-	-	-	-	-	-	96	96	96
-	-	-	-	-	-	70	84	88
-	-	-	-	-	-	66	76	80
4	-	5	3	1	-	0	40	78
5	-	7	1	-	-	0	38	80
-	-	-	-	-	-	84	92	92
-	-	-	-	-	-	92	94	94
-	-	-	-	-	-	92	92	92
-	-	-	-	-	-	80	94	94
-	-	-	-	-	-	88	68	70
2	-	5	1	-	-	12	42	72
-	-	-	-	-	-	92	80	88
-	-	-	-	-	-	82	92	92
-	-	-	-	-	-	98	98	98
-	-	-	-	-	-	98	98	9
-	-	-	-	-	-	88	96	96
-	-	-	-	-	-	86	94	94
-	-	-	-	-	-	64	88	90
-	-	-	-	-	-	68	88	94
-	-	-	-	-	-	78	80	88
-	-	-	-	-	-	70	82	82

TABLE III.

Seeds in Earth at 70 Degrees.

Upper row of figures- earth; lower row- sand.

	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>10</u>	<u>11</u>	<u>12</u>	<u>13</u>	<u>14</u>	<u>15</u>	<u>16</u>
pinch	-	-	-	1 2	-	1 6	2 1	2 0	1 1	1	-	-
"	-	-	-	1	-	3 4	2 2	1	-	1	1 0	-
ndish.	2	4 6	4 10	1 0	-	-	-	1 0	-	-	0	-
"	2	2 3	5 3	2 1	-	1	1	-	1 1	1	1 1	-
ndish '90.	-	-	5 8	4 3	-	2 3	-	1	1 0	-	-	-
"	-	6 10	1 2	2 1	-	3 3	-	1 0	1 0	0	-	-
cumber.	-	10 18	3 3	1 0	-	-	-	-	-	-	-	-
"	-	-	13 22	0 0	-	1 1	-	-	-	-	-	-
cumber '90.	-	-	-	-	-	1 2	1 1	0 4	2 1	1 1	-	-
"	-	-	-	-	-	-	-	-	3 1	1 1	1 2	-
mato.	-	-	-	-	-	-	-	19 24	1	1	-	-
"	-	-	-	-	-	-	-	20 24	-	-	-	-
mato '93.	-	-	-	-	-	-	-	-	2	3 21	5 3	-
"	-	-	-	-	-	-	-	-	-	3 18	5 3	-

<u>17</u>	<u>18</u>	<u>19</u>	<u>20</u>	<u>21</u>	<u>22</u>	<u>23</u>	<u>24</u>	Total at 6 days.	Total at 12 days.	Total.
								0	12	14
-	-	-	-	-	-	-	-	0	18	22 = 36
								8	10	18
-	-	-	-	-	-	-	-	8	16	13 = 30
								8	20	28
-	-	-	-	-	-	-	-	16	36	33 = 58
								4	18	22
-	-	-	-	-	-	-	-	20	32	38 = 60
								0	22	24
-	-	-	-	-	-	-	-	0	30	30 = 54
								12	26	38
-	-	-	-	-	-	-	-	20	32	32 = 60
								20	29	23
-	-	-	-	-	-	-	-	36	41	41 = 69
								0	30	30
-	-	-	-	-	-	-	-	0	43	40 = 70
								0	4	10
-	-	-	-	-	-	-	-	0	14	13 = 23
								0	0	14
-	-	-	-	-	-	-	-	0	1	10 = 24
								0	39	38
-	-	-	-	-	-	-	-	0	48	40 = 37
								0	40	42
-	-	-	-	-	-	-	-	0	48	43 = 50
								0	0	24
-	-	-	-	-	-	-	-	0	0	27 = 51
								0	0	26
-	-	-	-	-	-	-	-	0	0	44 = 70

(12)

TABLE III Continued.

	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>10</u>	<u>11</u>	<u>12</u>	<u>13</u>	<u>14</u>	<u>15</u>	<u>16</u>
Onion.								6	3	2	0	-
	-	-		-	-	-	-	9	8	3	1	-
"								2	3	2	1	-
	-	-	-	-	-	-	-	7	11	5	2	-
Onion '90.											2	
	-	-	-	-	-	-	-	-	-	-	1	-
Caraway.												
	-	-	-	-	-	-	-	-	-	-	-	-
Sage.									1	0	6	
	-	-	-	-	-	-	-	-	2	2	5	-
"									2	2	2	
	-	-	-	-	-	-	-	-	0	1	1	-
Sage '90.												
	-	-	-	-	-	-	-	-	-	-	-	-
"												
	-	-	-	-	-	-	-	-	-	-	-	-
Cabbage.				8		6	3			1		
	-	-	-	3	-	19	1	-	-	0	-	-
"				3		5	2			1		
	-	-	-	5	-	12	0	-	-	0	-	-
Cabbage '90.						5			2			
	-	-	-	-	-	14	-	-	2	-	-	-
"								1				
	-	-	-	-	-	10	-	3	-	2	-	-
Pepper.												
	-	-	-	-	-	-	-	-	-	-	-	-
"												
	-	-	-	-	-	-	-	-	-	-	-	-
Bean.							1	5	3		2	
	-	-	-	-	-	-	3	3	2	-	0	-
"								5	4	2	2	
	-	-	-	-	-	2	-	3	3	3	0	-

<u>17</u>	<u>18</u>	<u>19</u>	<u>20</u>	<u>21</u>	<u>22</u>	<u>23</u>	<u>24</u>	Total at 6 days.	Total at 12 days.	Total.
2		0	-	-	-	-	-	0	12	36
								0	18	42 = 78
1			-	-	-	-	-	0	4	14
								0	14	54 = 68
-	1	-	-	-	1	-	-	0	0	6
								0	0	4 = 10
-	-	-	1	-	-	-	-	0	0	2
								0	0	4 = 6
4								0	0	22
3	-	-	-	-	-	-	-	0	0	24 = 46
2								0	0	16
5	-	-	-	-	-	-	-	0	0	14 = 30
		1				1		0	0	4
2	-	1	-	-	-	0	-	0	0	6 = 10
2			1				1	0	0	8
4	3	-	0	1	1	-	0	0	0	18 = 29
								0	34	36
-	-	-	-	-	-	-	-	0	46	46 = 62
								0	20	22
-	-	-	-	-	-	-	-	0	54	54 = 76
1								0	10	16
-	-	-	-	-	-	-	-	0	20	32 = 38
1								0	2	4
0	-	-	-	-	-	-	-	0	30	40 = 44
	1	3	2	1		1		0	0	16
1	2	4	1	1	-	0	-	0	0	20 = 36
	3	3	1	1			1	0	0	18
-	3	4	1	0	-	-	0	0	0	20 = 38
	1	1						0	12	26
1	0	0	-	-	-	-	-	0	12	40 = 52
0								0	10	20
0								0	20	32 = 32

TABLE III Continued.

	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>10</u>	<u>11</u>	<u>12</u>	<u>13</u>	<u>14</u>	<u>15</u>	<u>16</u>
corn.	-	-	-	-	-	5	3	1	0	1	-	-
	-	-	-	-	-	2	2	3	2	1	-	-
"	-	-	-	-	-	1	4	3	1	-	1	-
	-	-	-	-	-	3	4	1	0	-	1	-
Water Melon '90.	-	-	-	-	-	-	-	1	1	-	1	-
	-	-	-	-	-	-	-	2	1	-	-	-
" "	-	-	-	-	-	-	4	1	2	-	-	-
	-	-	-	-	-	-	2	1	0	-	-	-
Chl Rabi '90	-	1	2	4	-	4	-	1	-	-	-	-
	-	4	7	4	-	2	-	0	-	-	-	-
" "	-	1	3	5	-	4	-	-	-	-	1	-
	-	1	6	2	-	5	-	1	-	-	0	-
ettuce.	-	-	2	3	-	6	1	-	-	1	-	-
	-	-	6	5	-	4	1	-	-	0	-	-
"	-	-	3	4	-	3	2	-	-	-	-	-
	-	-	5	3	-	5	1	-	-	-	1	-
urnip.'90.	-	-	2	1	-	3	-	-	-	-	-	-
	-	-	7	3	-	4	-	-	1	-	-	-
"	-	2	5	1	-	-	1	-	1	-	-	-
	-	5	9	2	-	-	0	-	0	-	-	-
quash.	-	-	-	-	-	-	-	-	1	5	3	-
	-	-	-	-	-	-	-	-	3	4	3	-
"	-	-	-	-	-	-	-	6	4	0	2	-
	-	-	-	-	-	-	-	2	4	3	1	-
ea.	-	-	-	-	-	3	2	3	1	-	1	-
	-	-	-	-	-	7	5	3	0	-	0	-
"	-	-	-	-	-	5	4	1	-	1	-	-
	-	-	-	-	-	9	3	0	-	1	-	-

<u>17</u>	<u>18</u>	<u>19</u>	<u>20</u>	<u>21</u>	<u>22</u>	<u>23</u>	<u>24</u>	Total at 6 days.	Total at 12 days.	Total.
								0	26	26
1	-	-	-	-	-	-	-	0	14	22 = 50
								0	18	22
-	-	-	-	-	-	-	-	0	22	24 = 46
		1						0	2	8
1	-	0	-	-	-	-	-	0	4	8 = 16
								2	10	14
1	-	-	-	-	-	-	-	0	6	8 = 22
								2	24	24
1	-	-	-	-	-	-	-	8	34	36 = 60
								0	24	26
-	-	-	-	-	-	-	-	2	30	30 = 56
								0	24	26
-	-	-	-	-	-	-	-	0	32	32 = 58
								0	24	24
-	-	-	-	-	-	-	-	0	28	30 = 54
								0	12	12
-	-	-	-	-	-	-	-	0	28	30 = 42
								4	18	20
-	-	-	-	-	-	-	-	10	32	32 = 52
1	1			1				0	0	24
0	1	-	-	0	-	-	-	0	0	32 = 46
1	2	-	-					0	12	30
1	0	-	-	-	-	-	-	0	4	22 = 52
								0	16	20
-	-	-	-	-	-	-	-		30	30 = 50
								0	20	22
-	-	-	-	-	-	-	-	0	24	26 = 48

TABLE IV.

Earth Test in Cold House.

[illegible]

<u>18</u>	<u>19</u>	<u>20</u>	<u>21</u>	<u>22</u>	<u>23</u>	<u>Total at 6 days.</u>	<u>Total at 12 days.</u>	<u>Total</u>
-	-	-	-	-	-	0	62	60
-	-	-	-	-	-	0	58	60
-	-	-	-	-	-	4	60	62
-	-	-	-	-	-	0	60	60
-	-	1	-	-	-	0	40	42
-	-	-	-	-	-	0	52	56
-	-	-	-	-	-	0	2	2
-	-	-	-	-	-	0	44	54
-	-	-	-	-	-	0	42	50
1	-	-	-	-	-	0	6	30
1	-	1	-	-	-	0	2	26
-	-	-	-	-	-	0	38	38
-	-	-	-	-	-	0	64	70
-	-	-	-	-	-	0	68	70
-	-	-	-	-	-	0	76	82
-	-	-	-	-	-	0	72	72
-	-	-	-	-	-	0	62	60
-	1	-	-	-	-	0	0	4
-	-	-	1	-	-	0	4	6
-	-	-	-	-	-	0	0	40
-	-	-	-	-	-	0	0	24
2	-	1	1	-	-	0	0	12
1	-	-	1	-	-	0	0	8

TABLE IV Continued.

	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>10</u>	<u>11</u>	<u>12</u>	<u>13</u>	<u>14</u>	<u>15</u>	<u>16</u>	<u>17</u>
Cabbage.	-	-	36	-	5	1	-	-	-	-	-	-
"	-	-	5	-	30	7	3	-	-	-	-	-
Cabbage '90.	-	-	-	-	11	2	4	3	2	-	1	2
"	-	-	-	10	4	1	-	6	1	-	1	-
Pepper.	-	-	-	-	-	-	-	-	-	-	6	6
"	-	-	-	-	-	-	-	-	-	-	-	3
Bean.	-	-	-	-	-	-	12	8	5	-	-	3
"	-	-	-	-	-	-	3	10	7	5	-	2
Corn.	-	-	-	-	-	2	9	4	3	4	-	4
"	-	-	-	-	14	9	2	-	-	-	-	1
Water Melon '90.	-	-	-	-	-	-	-	-	4	5	-	3
"	-	-	-	-	-	-	-	-	-	4	-	-
Kohl Rabi '90.	-	-	6	-	30	-	3	-	-	1	-	2
" "	-	-	7	-	13	2	1	2	-	7	-	2
Lettuce.	-	-	17	-	9	-	-	2	-	1	-	-
"	-	3	6	-	6	10	6	2	2	-	-	1
Turnip '90.	-	-	9	-	15	-	-	2	-	-	-	-
"	-	-	-	-	3	6	-	-	-	4	-	-
Squash.	-	-	-	-	-	-	-	6	15	3	-	2
"	-	-	-	-	-	-	3	12	2	2	-	1
Pea.	-	-	-	-	-	-	10	4	9	4	-	2
"	-	-	-	-	-	3	12	7	-	2	-	3

<u>18</u>	<u>19</u>	<u>20</u>	<u>21</u>	<u>22</u>	<u>23</u>	<u>Total at 3 days.</u>	<u>Total at 12 days.</u>	<u>Total</u>
-	-	-	-	-	-	0	24	34
-	-	-	-	-	-	0	90	90
-	-	-	-	-	-	0	34	50
-	-	-	-	-	-	0	30	46
4	3	1	1	-	-	0	0	42
3	5	3	1	4	-	0	0	40
-	-	-	-	-	-	0	24	56
-	2	1	-	-	-	0	0	60
1	-	1	-	-	-	0	22	56
-	-	-	-	-	-	0	50	52
1	-	-	-	-	-	0	0	26
1	2	1	1	-	-	0	0	26
-	1	-	-	-	-	0	56	64
-	-	-	-	-	-	0	46	62
-	-	-	-	-	-	0	36	92
-	-	-	-	-	-	0	62	72
-	-	-	-	-	-	0	42	52
-	-	-	-	-	-	0	22	36
-	-	1	-	-	-	0	0	54
-	1	1	-	-	-	0	16	54
1	-	-	1	-	-	0	20	62
-	1	-	-	-	-	0	30	56

The following table, V, is a summary of the preceding four, giving the average per cent of the duplicates in both the soil and the Geneva tests.

TABLE V.

Geneva Test Averages. Earth Test Averages.
60 Degrees. 70 Degrees. 60 Degrees. 70 Degrees.

	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$
Spinach.	73	82	63	37
Radish.	95	96	65	50
Radish '90.	79	91	50	57
Cucumber.	97	95	52	73
Cucumber '90.	63	73	28	26
Tomato.	93	97	64	39
Tomato '93	62	65	79	74
Onion.	73	92	70	80
Onion '90.	8	6	5	5
Caraway.	9	2	0	3
Caraway '90.	3	4	0	0
Sage.	30	59	52	53
Sage '90.	42	26	10	18
Cabbage.	96	97	80	73
Cabbage '90.	72	82	43	46
Pepper'	29	79	41	36
Bean.	96	93	57	57
Corn.	97	93	54	43
Water Melon '90.	83	71	25	19
Kohl Rabi '90.	54	90	66	53
Lettuce.	93	93	59	56
Turnip '90.	83	95	44	47
Squash.	95	92	53	49
Pea.	97	84	50	49

A glance at the table shows that, as would naturally be expected, the older seeds start up slower and come on in a more straggling manner than do the new seeds. For instance in the Geneva test at 70 degrees the new cucumber seed have all germinated on the sixth day, while those of 1890 are still coming on the thirteenth, or seven days later. The same is true to a greater or less degree of all the seeds.

It was also seen in the Geneva tester, that, though many seeds cracked and apparently began to sprout, they did not seem to have sufficient vitality to develop into a young plant. This was very conspicuous in the case of the onion.

The soil experiment recorded in Table III is varied, the seeds being laid on soil and half of the row covered with light sand, the other half being well covered with the same earth as below, that being a very rich soil. Though the seeds were not divided accurately, this experiment being an after-thought, a glance at the tables shows that those covered with sand did much better than those in the earth, presumably because the sand did not pack so hard over the seeds, giving them a better chance to come up, and because the rich soil at best helps to bring on decay.

In comparing the work of the two Geneva testers, the one at 70 degrees and the other at 60 degrees, that of the higher temperature has the larger number of seeds germinated on the average. It is also seen that seeds have a tendency to start quicker and more vigorously in the warm temperature. For example in the colder test, but nine radishes came up on the third day on the average, while in the warmer test, about forty-two appear. On the other hand, decay sets in so much quicker in the warmer temperature, as to nearly counterbalance the advantage of a quick start.

In examining the results of the soil experiments, at first view, one might think the same does not hold true. As to actual results, in most cases it does not. However, on looking more carefully, it will be seen, that had all the seeds been covered with sand, the advantage would

again lay with the warmer house. For instance the radish, which shows up better in the cold house, would average 70%, instead of 50%, if it were all covered with sand, whereas in the colder test it averages but 65%. The falling off may be accounted for largely through decay, caused by the richness of the soil about the seeds, which combined with the greater warmth, probably killed off many seeds.

The temperatures at which seeds germinate best varies with the seed. Below are lists of seeds which did considerably better at one temperature than at another.

At 70 Degrees.

Onion.
Tomato.
Cucumber.
Sage.
Turnip '90.
Radish '90.

At 60 Degrees.

Pea.
Lettuce.
Radish
Cabbage.
Corn.
Squash.
Spinach.
Water Melon '90.

The only explanation of the radish '90 and the turnip '90 doing better at the warmer temperature, is that they are old seeds and probably need a greater stimulant to bring them to germinate. That the corn and the water melon should do best at the colder temperature, when they are usually much better at a higher temperature can only be explained by decay of seeds during the test.

As to the age that seeds may be kept, it is found that radish, cabbage, turnip, cucumber, water melon, and kohl rabi seeds may be kept eight years and still do well. Of the above list, the cucumber and water melon show up much better in the Geneva test than in the soil. Sage seed does fairly well compared with new seed, though the new seed itself is rather poor. On the other hand, onion, parsnip, and caraway seed make

scarcely any showing after eight years. As regards the caraway seed, it turns out so consistently bad as to arouse grave doubts as to whether some mistake was not made in the sample, as the new seeds give if possible worse results than those known to be old.

The great question which this investigation was to answer is,- "Does the Geneva tester really tell anything how seed will act when actually planted. The answer is both "Yes" and "No". It tells if there is any life in the seed, and what number has a possibility of coming up but it does not tell with any great degree of accuracy, how many will grow. It gives but an indication, and the falling off of the percentage of those planted in the earth, compared with the percentage shown by the Geneva tester, will amount to from ten per cent in case of the spinach, to forty-two per cent as in the case of the corn, depending on the seed and the condition. The seed tested in the Geneva tester has such a comparatively easy time in sprouting, having the right amount of moisture supplied it continually, no pressure to resist its sprouting, and an even temperature,- in fact, having all the conditions to induce germination. A seed tested in soil may be supplied the moisture and even temperature, but the pressure of the soil about the seed and the packing of the soil can not be avoided, hence the seed in the ground cannot be expected to make as good a showing as that in the Geneva tester.

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