Inheritance of Earliness in Oats

Thesis for Degree of M. S.

ROBERT LESTER BUCHANAN

1915

INHERITANCE OF EARLINESS IN OATS

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(Printed by Prof.Spragg)

These pictures show the field variety test plat of oats at the Michigan Station in 1914.The plats lighest in color are the ripest.Every plat is homozygous in ripeness, but there is a 2 day period between some of the plats.

CONTENTS

INHERITANCE OF EARLINESS IN OATS

OBJECT

To study inheritance in oats in regard to ripeness.

INTRODUCTION

These oats have been under observation since 1908 by Profesor Spragg,as part of his regular work.This investigation was really started in 1911,but two years were spent increasing and segregating the material.In 1913,Mr. Spragg was not able to give this work his personal attention,but he had one of his men give all his spare time to harvesting the oats.Mr.Matthews found five classes which he and Profesor Spragg designated as "Dead Ripe","Ripe", "In Milk","Heading",and "Not Heading".The material was tied in bundles,properly labeled,and hung in the store room.

In the fall of 1913 the author took charge of this work and carefully went over all the material.With suggestions from Profesor Spragg,the groups were interpreted as possible Mendelian ratios and selections were made for carrying on the work in 1914.The data obtained by Profesor Spragg and Mr.Matthews is included in the thesis to show clearly the history of the material and the basis on which the 1914 work was started.

ACKNOWLEDGEMENTS

To Profesor Spragg,East Lansing,Mich.for suggestions, for the material highly developed,for planting the oats at

East Lansing in 1914,and for correcting the thesis.

To Mr.E.F.Gaines and Mr.Matthews for gathering oats at Pullman and East Lansing.

METHOD.

When the first oats were Dead Ripe,a second class was Ripe,and other groups were found In Milk,Just Heading, and Not Heading.Several of the plats were pulled at this time,classed under these headings and counted.As no seed would grow from plants treated in this way,only the Dead Ripe and Ripe were removed from the remaining plats on July 27th.Later observations led the Farm Crops Department to decide that there was probably one week between the ripening of the classes.Thus July 27,Aug.3,10,17,and 24th may be considered the approximate dates of ripening of the different groups.

Here we consider ripeness and absence of ripeness (lateness) as an allemorphic pair.If there is only one factor for ripeness present,a 1:2:1 ratio should occur in the absence of dominance.In this case with complete dominance the ratio should be 3:1.In case there are two factors,with complete dominance,the ratio should be 15:1. With incomplete dominance the ratio should be 9:6:1,or in the absence of dominance a ratio of 1:1:1:1:2:2:2:2:4. With three factors,in complete dominance the ratio should be 63:1,or in incomplete dominance 27:27:9:1.In case four factors for ripeness are present,in complete dominance the ratio should be 255:1,or in incomplete dominance a ratio of 81:108:54:12:1.

The plats having similiar segregations are grouped together.The segregations are not identical.All plats are included in the ratios.In some instances the plats are not in the group that the number of segregations present would indicate,but in a group having a greater number of segregations,since at times the numbers indicate that some groups are missing.

DATA FOR 1913.

TABLE 1.

Plat number	Dead Ripe	Homozygous
3	all	"
105	"	"
106	"	"

Plats 3 and 105 are homozygous in ripeness,that is all the plants ripened at the same time.Plat 106 had a few plants in a later class,but so few they were disregarded.

TABLE 2.

Plat number		Dead Ripe		Ripe
5		81		31
28		124		24
29		149		51
32		117		17
33		26		6
97		355		52
98		25		24
102		276		9
104		319		28
107		27		117
		1499		359
Total	1859			
Ratio		3.2270	:	.7730
Expected		3.0000	:	1.0000

The ratio expected here is the ratio that should occur if only one factor for ripeness is present.As the number of individuals is not so very large the ratio obtained is probably as close as could be expected.From this group we have the best chance to isolate the Dead Ripe and Ripe classes.Selections were made from plat 5 for this purpose.

TABLE 3.

Plat number	Dead Ripe	Ripe	In Milk
4	77	39	1
19	75	57	18
20	52	42	9
30	28	4	1
31	362	78	18
34	14	16	3
35	43	48	8
38	91	60	23
39	84	117	35
40	27	27	5
43	80	66	3
44	14	19	14
83	44	158	16
86	130	82	24
87	9	3	0
88	67	45	0
100	48	18	1
101	37	12	0
	1282	891	179
Total 3352			
Ratio	8.7211 :	6.0612 :	1.2177
Expected	9.0000 :	6.0000 :	1.0000

This expected ratio is the ratio two factors should give if there is incomplete dominance.Considering the small number of plants this is really quite close to the expected ratio.From this group we have the best chance to isolate the In Milk ripeners,with a smaller chance to isolate the Dead Ripe and Ripe.

TABLE 4.

Plat number	Dead Ripe	Ripe	In Milk	J.Heading
21	36	38	30	18
22	39	10	5	1
23	45	24	38	1
26	57	66	42	5
27	26	23	8	0
36	1	82	25	0
37	11	61	34	0
41	7	17	25	3
42	27	87	32	0
68	15	39	72	7
69	69	89	68	1
75	3	46	71	0
76	19	62	105	3
85	61	72	86	28
89	270	99	8	2
90	30	4	0	0
91	193	7	12	0
92	102	140	35	1
93	167	77	50	0
95	31	112	65	1
96	26	97	116	11
99	273	26	2	2
108	43	71	5	5
	1551	1349	934	89

Total 3923

Ratio 25.3031:22.6.76 : 15.2373 :1.4520

Expected 27.0000:27.0000 : 9.0000 :1.0000

In this group which seems to contain three factors, with incomplete dominance the ratio should be 27:27:9:1. The ratio obtained is farther from the expected than the last. Yet it is quite possible that some plants from the Ripe class were placed in the In Milk class as the distinction between the two classes is hard to make.

TABLE 5.

Plat no.	D.Ripe	Ripe	In Milk	N.Heading	J.Heading
17	23	24	56	36	3
18	43	107	109	15	5
24	63	35	69	5	3
25	228	153	69	7	2
70	55	155	72	0	0
71	56	56	50	0	0
72	16	33	88	15	4
73	3	17	43	4	0
74	3	13	29	4	1
77	31	80	159	0	0
78	25	89	141	0	0
81	99	147	91	0	0
82	14	62	18	0	0
	699	971	994	86	18
Total	2768				
Ratio	61.8416	91.1202	93.2786	8.0704	1.6893
Expected	81.0000	108.000	54.0000	12.000	1.0000

In this group we find a wide variation from the expected ratio.But the difficulty of separating the various groups,together with the large number of classes and the small number of individuals may account for this.The ratio expected here is that of incomplete dominance.

TABLE 6.

Plat number	In Milk	J.Heading	N.Heading
6	110	99	1
11	21	132	5
13	160	24	1
15	55	48	2
16	10	10	0
45	72	65	3
46	160	88	0
47	270	153	2
48	65	198	0
49	40	48	0
54	129	34	0
55	46	36	2
60	127	112	31
61	180	73	9
62	150	58	13
66	111	174	18
67	76	69	1
	1772	1421	88

Total	3281		
Ratio	8.6413	:6.9296	: .4291
Expected	9.00000	:6.0000	: 1.0000

In the case of incomplete dominance the ratio should be what is given as the expected ratio.The Just Heading group is larger than expected,but owing to the method of harvesting some of the plants from the other classes might easily have been placed in this group.So this ratio may be considered as indicating a 9:6:1 ratio.

TABLE 7.

Plat number	Just Ripe	In Milk	Just Heading
79	12	67	20
80	58	183	36
94	101	201	3
	171	451	59

Total	681		
Ratio	1.0044	: 2.6490	: .3460
Expected	1.0000	: 2.0000	: 1.0000

This ratio is found for the first time in this group of plants.In all the ratios so far there has been strong indication of partial dominance.This should give a 3:1 or in the case of absence of dominance a 1:2:1 ratio. It is possible that in some cases there is really an absence of dominance,but I think this ratio may be explained partly by the small number of plants,and that a large number of plants would probably give a different ratio.

TABLE 8.

Plat number	In Milk	J.Heading	N.Heading
7	235	7	
8	124	45	
9	138	46	
10	66	22	
12	150	35	
14	149	16	
50	88	113	
51	24	17	
52	115	77	
53	39	32	
56	224	89	
57	144	83	
58	173	130	
59	23	24	
63	176	29	2
64	200	36	0
65	21	9	0
	2089	810	2

Total 2901

Ratio 2.8803 : 1.1179 : .0028

Expected 3.00000: 1.0000 : .0000

In this group we have a relatively large number of individuals segregating into two main classes.The ratio obtained is quite close to the expected in the case of dominance.

SELECTIONS MADE FROM THE 1913 DATA.

In the fall of 1913,I took charge of this work which until this time had been carried on by Profesor Spragg and his assistants.Profesor Spragg aided with valuable suggestions in the grouping of the material and in making the selections to carry on the work in 1914.In practically all the plats earliness(ripeness)seemed dominant over lateness.Thus a plat having plants in the

Dead Ripe class would have only 4D or 4 Duplex.If there were plants in the Ripe class also there would be 3D plas S.If plants in the first three classes there would be 2D plus 2S and so on.Selections were made in an attempt to get 4D,3D,2D,1D,OD,2D plas S,and segregations from plants supposed to be 4S.In all cases only plants homozygous in black and white,and hulled and hulless, were selected.

Plat no.	Selection
4	Best 10 pure hulless plants.Dead Ripe
5	Same as 4.
17	All available pure hulless plants.
23	Dead Ripe and Ripe.20 white hulless plants.
47	I.Milk and J.Heading.20 pure hulless.
56	Best 10 plants as in 47.
63	Same as in 56.
79	Best 20 pure hulless plants.Ripe.
80	Same as in 79.
85	Best 20 D.Ripe and Ripe.White and hulless.
94	Best 20 plants from the Ripe class.
107	Best 20 plants from Dead Ripe and Ripe classes.
112	Same as 107.

INDICATIONS FROM THE 1913 DATA.

1.These oats segregate in regard to ripeness.

2.These segregations take place according to Mendelian ratios.

3.The time between segregations seems to be about one week.

4.With the exception of plats 3,105,and 106,all the plats are heterozygous in regard to ripening.

5.It is possible by selection to get oats homozygous in ripening and these may be of commercial importance as well as of scientific interest.

6.Earliness or ripeness is dominant over lateness.

1914.

From the ratios obtained in 1913,the chance of obtaining the desired types in 1914 was determined mathematicaly.To be more certain of getting what was wanted from three to five times the required number of plats were planted.Material from different sources(accession) numbers was grouped together because it was thot to have similiar factors for ripening.

Accession 105 is a selection from ac.28 which is S.P.I.number 21231.This came from China.

Accessions 106 and 107 are selections from ac.29 which is S.P.I.number 21233.This also came from China.

Accession 108 was obtained from the Rossman Bros.,Lake View,Michigan.

Accession 112 is the product of a cross in 1911 of Chinese Hulless and Alexander.

Most of the oats were planted at East Lansing by Profesor Spragg.A few plats were planted at Pullman, Wn.In the latter case the factor of acclimitization must be considered.

TABLE 9(HISTORY OF THE PLATS).

Plat 1914	Plat 1913	Ac.no.	Wanted	Parent
1	5	112	4D	3D plus S
2	"	"	"	"
3	"	"	"	"
4	"	"	"	"
5	"	"	"	"
6	107	107	"	"
7	"	"	"	"
8	"	"	"	"
9	"	"	"	"
10	"	"	"	"
11	112	108	"	"
12	"	"	"	"
13	"	"	"	"
14	"	"	"	"
15	"	"	"	"
16	"	"	"	"
17	"	"	"	"
18	"	"	"	"
19	107	107	3D	"
20	"	"	"	"
21	"	"	"	"
22	"	"	"	"
23	"	"	"	"
24	112	108	"	"
25	"	"	"	"
26	"	"	"	"
27	"	"	"	"
28	"	"	"	"
29	47	105	2D	2S
30	"	"	"	"
31	"	"	"	"
32	"	"	"	"
33	"	"	"	"
34	"	"	"	"
35	"	"	"	"
36	"	"	"	"
37	"	"	"	"
38	"	"	"	"
39	"	"	"	"
40	"	"	"	"
41	"	"	"	"
42	"	"	"	"
43	"	"	"	"
44	"	"	"	"
45	"	"	"	"
46	56	"	"	"
47	"	"	"	"
48	"	"	"	"
49	"	"	"	"
50	"	"	"	"

TABLE 9(CONTINUED).

Plat 1914	Plat 1913	Ac.no.	Wanted	Parent
51	56	105	2D	3D plus S
52	"	"	"	"
53	"	"	"	"
54	"	"	"	"
55	63	"	"	D plus S
56	"	"	"	"
57	"	"	"	"
58	"	"	"	"
59	"	"	"	"
60	"	"	"	"
61	"	"	"	"
62	"	"	"	"
63	"	"	"	"
64	47	"	OD	2S
65	"	"	"	"
66	"	"	"	"
67	"	"	"	"
68	"	"	"	"
69	"	"	"	"
70	"	"	"	"
71	"	"	"	"
72	"	"	"	"
73	"	"	"	"
74	"	"	"	"
75	"	"	"	"
76	"	"	"	"
77	"	"	"	"
78	"	"	"	"
79	"	"	"	"
80	"	"	"	"
81	"	"	"	"
82	"	"	"	"
83	"	"	"	"
84	56	"	1D	D plus S
85	"	"	"	"
86	"	"	"	"
87	"	"	"	"
88	"	"	"	"
89	"	"	"	"
90	"	"	"	"
91	"	"	"	"
92	"	"	"	"
93	"	"	"	"
94	20	"	2D plus S	2D plus 2S
95	"	"	"	"
96	"	"	"	"
97	"	"	"	"
98	"	"	"	"
99	"	"	"	"
100	"	"	"	"

TABLE 9(CONTINUED).

Plat 1914	Plat 1913	Ac.no.	Wanted	Parent
101	20	105	2D plus S	2D plus 2S
102	"	"	"	"
103	"	"	"	"
104	79	106	"	3S
105	"	"	"	"
106	"	"	"	"
107	80	"	"	"
108	"	"	"	"
109	"	"	"	"
110	"	"	"	"
111	"	"	"	"
112	"	"	"	"
113	"	"	"	"
114	"	"	"	"
115	"	"	"	"
116	"	"	"	"
117	"	"	"	"
118	"	"	"	"
119	"	"	"	"
120	94	106	"	"
121	"	"	"	"
122	"	"	"	"
123	"	"	"	"
124	"	"	"	"
125	"	"	"	"
126	"	"	"	"
127	"	"	"	"
128	"	"	"	"
129	"	"	"	"
130	17	105	Segregations	4S
131	"	"	"	"
132	"	"	"	"
133	"	"	"	"
134	"	"	"	"
135	"	"	"	"
136	"	"	"	"
137	"	"	"	"
138	"	"	"	"
139	"	"	"	"
140	"	"	"	"
141	"	"	"	"
142	"	"	"	"
143	"	"	"	"
144	"	"	"	"
145	"	"	"	"
146	"	"	"	"
147	"	"	"	"
148	"	"	"	"
149	"	"	"	"
150	"	"	"	"

TABLE 9(CONTINUED).

Plat 1914	Plat 1913	Ac.no.	Wanted	Parent
151	17	105	Segregations	48
152	"	"	"	"
153	"	"	"	"
154	"	"	"	"
155	"	"	"	"
156	"	"	"	"
157	"	"	"	"
158	"	"	"	"
159	"	"	"	"
160	"	"	"	"
161	"	"	"	"
162	"	"	"	"

TABLE 10.

Plat no.	Segregations and dates									Total
	7/23	7/25	7/27	7/29	7/31	8/3	8/5	8/7	8/10	
1	55	91	43	3						192
2	91	63	21	0						175
3		72	70	19						200
4	64	67	9	4						144
5		40								40
6			62	29	20					111
7			49	62	14					125
8			56	23	17					96
9			50	42	29					121
10			49	55	12					116
11			16	11	114	3				144
12				7	136	0				143
13				8	144	7				159
14				22	109	0				131
15					117	3				120
16					120	11				131
17					106	7				113
18					69	22				91
19					86	27				113
20					111	41				152
21					78	16				94
22					119	57	2			178
23			12		117	13				142
24					136	1				137
25					219	7				226
26					128	9				137
27					118	7				125
28						93	14			107
29					2	4	67	84		175
30						3	80	32	41	156
31							8	12	53	73
32						2	4	13	52	71

TABLE 10(CONTINUED).

Plat no.	Segregations and dates									Total
	7/31	8/3	8/5	8/7	8/10	8/15	8/17	8/19	8/21	
33			15	34	50					99
34		17	32	29	13					91
35		12	92	18						122
36		22	70	59	15					166
37		66	51	5						122
38		36	31	10						77
39	1	106	115	16						238
40		4	49	38						91
41		36	126	40						202
42		90	65	15						170
43		40	37	26						103
44		26	75	33						134
45		50	110	17						177
46		28	38	48						114
47				54						54
48			39	21						60
49			55	21						76
50		42	30	17						89
51		108	82	4						194
52		9	27	24						62
53		35	21	10						66
54			14	51						65
55				69	75					144
56			18	34	23					75
57				14	41	20	16			91
58				1	8	33	28			70
59				1	26	16	58			101
60					1		18	12	28	59
61								23	42	65
62						16	34	26	33	109
63								8	9	17
64							12	14		26
65							26	8		34
66							25	16		41
67					11	15	23	18		67
68		3			59	13	44	33		149
69							21	14	18	53
70							25	35	26	86
71		1	11	62	41	23	35			173
72		6	70	64	69					209
73			46	34	23					103
74		1		45	67					113
75		13	23	21	4					61
76		47	33	15						95
77		75	25							100
78		30	37	17						84
79			59	63						122
80			50	22						72

TABLE 10(CONTINUED).

Plat no.	Segregations and dates.									Total
	7/25	7/27	7/29	7/31	8/3	8/5	8/7	8/10	8/15	
81						28	30			58
82						19	22			41
83						30	46			76
84						42	33			75
85					19	65	65	11		160
86							61	23		84
87						8	45	53	12	118
88					4	41	56	12		113
89				2	6	39	83	22		152
90						94	55	7		156
91					70	71	47	19		207
92					102	18				120
93					61	15				76
94	28	41	9	24	22					124
95		15	32	72	16					135
96				55	18	2				115
97				75	138	4				217
98		19	47	17	28					111
99			55	60						115
100					91	45				136
101				26	89					115
102		5	12	55	36					108
103		4	15	39	29	5				92
104				5	4					9
105		11	11	28	7					57
106			13	22						35
107			3	87	9					99
108				33	40					73
109				18	49					67
110				21	37					58
111				48	48	17	11	4		128
112				44	22					66
113		1	37	26						64
114		4		24	56	17	37			138
115				15	21	1	16	2		55
116		10	11	54	55	10	15	8		163
117			17	61	55	1				64
118			3	80	30	3				116
119					41					41
120			1			74	46			121
121						66	24	10		100
122						35	28	18		81
123						21	14			35
124						28	23	10		61
125						24	28	29		81
126						30	29	23		82

TABLE 10(CONTINUED).

Plat no.	Segregations and dates.									Total
	7/25	7/27	7/29	7/31	8/3	8/5	8/7	8/10	8/15	
127						41	27	38		106
128							26	9		37
129						13	22	28		63
130				24	45	14	7			90
131				50	88	30	22			190
132			9	63	54	28				154
133		26	24	63	31	31	4			179
134			20	40		25				85
135	33	49	27					12		121
136	23	36	5	15						79
137		31	29	32	8					100
138			3	40	7	2				52
139	40	17	0	0	1					58
140		8	2	30	34	4				78
141		9	21	34	21	5				90
142		1	0	33	17	10				61
143		6	35	34	12					87
144		9	14	21	4					48
145		6	9	12	5					32
146		17	14							31
147		4	3	22		20	3			52
148			13	11	10					34
149				15	10					25
150				14		7				21
151		1			2					3
152				18	68	0	6			92
153	9	17	8	38	35	9	2			101
154		14	56	41	38	5				154
155		20		15	12	17	6			70
156		8	21	53	24	11	2			119
157		1	9	20	27	14	5			76
158		6		43	32	6				87
159			1	19	23	5	17			65
160		12	8	15	18	10	5			68
161			7	10	12	16	5			50
162						63	3			66

On August 10th there was a very heavy rain which caused the oats to turn green again.This accounts for the long period from the 10 to the 15th,during which no oats ripened.

In the summer of 1914 the oats were watched carefully and gathered as fast as they ripened.Instead of the

expected one week segregations it was found that they fell naturally into two day segregations.Two conditions tended to make the separation into classes more difficult than usual.(1)Some plats were badly smutted.(2)Heavy rains toward the end of the ripening period caused the oats to turn green again.Evidently the harvesting was not watched carefully enough in 1913 and in many cases several segregations must have been gathered as one.Consequently the selections made from these in order to obtain some particular type,in most cases broke up into many segregations.Yet in several cases all the plants in the plats ripened at the same time,thus proving that they are homozygous.In general all the plats from the same parent plant had similiar segregations.

TABLE 11.

Plat number	Segregations and dates ripe.			
	7/23	7/25	7/27	7/29
1	55	91	43	3
2	91	63	21	0
4	64	67	9	4
	210	221	73	7

Total 511

Ratio	26.3014	:27.6790	:9.1429	: .8767
Expected	27.0000	:27.0000	:9.0000	: 1.0000

This is the ratio expected with three factors and incomplete dominance.Considering the small number of individuals in this group the ratio obtained is very close to the expected ratio.Plat 5 from the same parent plant proved homozygous in ripeness.

TABLE 12.

Plat number	Segregations and dates ripe		
	7/27	7/29	7/31
6	62	28	20
7	49	62	14
8	56	23	17
9	50	42	29
10	49	55	12
	266	211	92
Total	569		
Ratio	7.4796	: 5.9332	:2.5870
Expected	9.0000	: 6.0000	:1.0000

This is the ratio expected with two factors in partial dominance. These plats all came from the same parent in 1913. The segregations are quite similiar. This ratio is near enough to the expected to be possible when the very small number of individuals is considered.

TABLE 13.

Plat number	Segregations and dates ripe			
	7/29	7/31	8/3	Ratio approximately
12	7	136	o	1:18
13	8	144	7	?
14	22	109	0	1: 5
15		117	3	39: 1
16		120	11	11: 1
17		106	7	15: 1
18		69	22	3: 1
24		136	1	136: 1
25		219	7	31: 1
26		128	9	14: 1
27		118	7	17: 1
28			93 14	6: 1

These plats all came from the same plat in 1913. This was plat 112 and belongs to accession number 108. The ratio in 1913 was 3:1, but this data shows that it

should have been much larger.These ratios show that ripeness is dominant in all but two plats.In plats 18 and 28 there is a 3:1 ratio and this indicates the presence of one factor for ripening with dominance.Plats 16,17,26. and 27 give ratios which indicate the presence of two factors for ripening.Plats 15 and 25 give ratios of over 30:1. These may indicate a still higher ratio,but I am inclined to think that a few plants which belong to the lower class have been placed in the higher class.Plat 24 gives a ratio of 136:1.This may indicate a still higher ratio,with more factors present,but I think this can be explained in the same way as the 30:1 ratio just given above.This is quite likely a 63:1 ratio,or possibly enen a 15:1 ratio.Plats 12 and 14 of the same group give a reversed ratio.Such a ratio is found occassionly and has usually been noted as reversed dominance.Little explains this on the basis of the presence of a different number of factors.In this same group plats 11 and 13 break up into a large number of segregations which do not resemble any known ratios. These two plats seem to indicate a complete absence of dominance.In some of the ratios from this group.there are indications of the presence of one,and in others the presence of two factors for ripeness.The higher ratios may possibly indicate the presence of more factors.These ratios are comparable to those obtained by East and Hays in their work with color factors in corn.

If we accept Little's explanation(Science Dec 18, 1914),we can explain the reversed dominance.But according to his explanation we would have to grant,in such a ratio as 136:1,the presence of about 18 factors.This may be possible,but I prefer the explanation of this on the basis of complete dominance in the presence of a smaller number of factors.

TABLE 14.

Plat number	Segregations and dates ripe		
	7/31		8/3
19	86		27
20	111		41
21	78		16
22	119		59
	394		143
Total 537			
Ratio	2.9348	:	1.0652
Expected	1.0000	:	1.0000

Such a ratio as this is to be expected in the case of dominance in the presence of one factor.This is really quite close to the expected ratio.These came from the same parent plant in 1913.All in the group segregated in the same way except plat 23 which has three segregations.These may belong to the two classes as the others since the extra class is very small compared to the others.In this group there is a 4 day period instead of 2 as in the other groups.

TABLE 15.

Plat number		Segregations and dates ripe	
		7/31	8/3
108		33	40
109		18	49
110		21	37
112		44	22
		116	148
Total	264		
Ratio		1	: 1.2
Expected		1	: 1.1

In this group there is a reversed dominance.The plats all came from the same parent plant in 1913.The expected ratio is that given by Little in the presence of three factors.The ratio obtained in this group is really quite close to the expected as given by Little.

TABLE 16.

Plat number		Segregations and dates ripe		
		8/3	8/5	8/7
35		12	92	18
37		65	51	5
38		36	31	10
40		4	49	38
41		36	126	40
42		90	65	15
43		40	37	26
44		26	75	33
45		50	110	17
39		107	115	16
76		47	33	15
78		30	37	17
		544	821	250
Total	1615			
Ratio		5.3895	: 8.1337	: 2.9778
Expected		4.0000	: 8.0000	: 4.0000

All the plants in this group came from the same parent plant in 1913.The expected ratio given here is the ratio that should occur in the case of one factor with entire absence of dominance.The same ratio occured in a small group in the 1913 data.

TABLE 17.

Plat number	Segregations and dates ripe		
	8/3	8/5	8/7
46	28	38	48
50	42	30	17
51	108	82	4
53	35	21	10
	213	171	79
Total	463		
Ratio	7.3348 :	5.9000 :	2.7241
Expected	9.0000 :	6.0000 :	1.0000

This is the ratio that should occur with two factors and incomplete dominance.These plats all came from the same parent plant in 1913.The ratio obtained is a wide variation from the expected ratio,but the small number of individuals will partly account for this.Plat 47 from the same parent plant may be considered homozygous as all the plants ripened on August 8th.

Plat 119,a selection from plat 80 in 1913,is homozygous in ripeners as all the plants ripened at the same time and were gathered August 3d.

TABLE 18.

Other plats showing promising ratios

Plat number	Segregations			Ratios		
54	14	51		.8614	: 3.1385	
55	69	75		30.7777	: 33.2222	:0:0
61	23	42		1.4154	: 2.5746	
65	26	8		3.0590	: .9410	
77	75	25		3.0000	: 1.0000	
80	50	22		2.7778	: 1.2222	
86	61	23		2.9048	: 1.0952	
90	94	55	7	9.7436	: 5.6410	:.6460
93	61	15		3.2105	: .7895	
100	91	45		2.0000	: 1.0000	
101	26	89		.9300	: 3.0700	

These plats are given merely as indicating promising ratios.They do show the two day segregations and in a few cases the reversed dominance such as was noted in Table 13.

DATA AT PULLMAN,WASHINGTON.

These plats were harvested by Mr E.F.Gaines while I was harvesting the plats at East Lansing,Mich. The oats were grown under experimental conditions in the cereal nursery.As at East Lansing the oats were watched carefully and gathered as fast as they ripened.

TABLE 19(HISTORY OF THE PLATS).

Plat 1914	Plat 1913	Ac.no.	Wanted	Parent	Clase
1	4	112	4D	3D plus S	D.Ripe
2	5	112	"	"	"
3	20	105	"	"	"
4	23	"	"	"	"
5	47	"	3D	3S	I.Milk
6	"	"	"	"	"
7	56	"	"	"	"
8	"	"	"	"	"

TABLE 19(CONTINUED).

Plat 1914	Plat 1913	Ac.no.	Wanted	Parent	Class
9	63	105	2D	1D plus S	I.Milk
10	80	106	3D	3S	Ripe
11	"	"	"	"	"
12	85	"	4D	D plus 3S	D.Ripe
13	94	"	3D	3S	Ripe
14	"	"	"	"	"
15	107	107	4D	3D plus S	D.Ripe
16	112	108	"	"	"

TABLE 20.

Plat no.	Segregations and dates								
	8/1	8/3	8/5	8/7	8/9	8/13	8/20	Total	Composition
1	80							80	Homozygous
2	60							60	"
3		14	67	115				196	Heterozygous
4		33	171					254	"
5					60			60	Homozygous
6					75			75	"
7						110		110	"
8						6		6	"
9						65		65	"
10	1		1					2	Heterozygous
11	90		4					94	"
12		79	30					109	"
13					80			80	Homozygous
14					101			101	"
15		11		79				90	Heterozygous
16		95						95	Homozygous

DISCUSSION OF RESULTS AT EAST LANSING, MICHIGAN.

The presence of numerous segregations which were not noted in 1913 prevented the results from being what was expected. Instead of segregations one week apart as in 1913, in practically all the plats which were not homozygous there were two day segregations. This data with a few exceptions shows that ripeness is dominant, but that the dominance is incomplete. In the 1914 plats from plat

112 in 1913,the ratios indicate that in this group at least,there are two factors and one factor present.Of the plats in 1914,plat no.5 is possibly homozygous, while 47 and 119 are homozygous as all the plants ripened at the same time.

As in 1913 plats from the same parent plant segregated in much the same way.Those having similiar segregations were grouped and the ratios determined.But in groups having many segregations the total number of individuals is so small that the results do not even approximate Mendelian ratios.In such cases the grouping is omitted,because with the small number of individuals the misplacing of one or two plants would cause a wide variation in the ratio.

The summer was unusually dry at Lansing.The soil which is a sandy loam dried out very rapidly.So it is possible that some of the oats may simply have died and not ripened.All we can do is to assume that all the oats were affected in the same way.Yet,on Aug.10th a heavy rain fell and this caused the unharvested oats to turn green.

DISCUSSION OF RESULTS AT PULLMAN,WN.

The soil used was a heavy loam,formed of decomposed volcanic rock.This soil holds water very well.The oats received no rain from the time they were planted until they were harvested.The oats were planted later

than at Lansing and the cool nights which are characteristic of the region tended to make the harvesting later.

As at East Lansing the oats were carefully watched and harvested in the same way.In the plats that segregated two day periods were found.Yet in the plats which proved to be homozygous in ripeness we find periods of about one week between the dates of ripening.

Plat number	Supposed to be	Date ripe	Homozygous
1	Dead Ripe	8/1	"
2	"	"	"
12	"	8/3	"
5	In Milk	8/13	"
6	"	"	"
7	"	8/20	"
8	"	"	"
9	"	"	"
13	Ripe	8/13	"
14	"	"	"

Considering the Dead Ripe on 8/1,the Ripe should be about 8/8,the In Milk about 8/15,and the Just Heading about 8/22,according to the segregation periods found in the 1913 data.If these are the approximate days on which the groups should ripen,no Ripe class was found.It is entirely possible that the plants put in the Ripe class and selected for planting in 1914 should have been thrown into the In Milk class.The results in the 1914 data bear out this supposition.Two of the plats(5 and 6)In Milk,proved homozygous and ripened Aug.13th.,two days early in comparison with the Dead.Ripe.The other plat supposed to be in the Milk ripened Aug.20th.This was also 2 days early compared to the Dead Ripe.It is quite evident here that

the last plats should have been placed in the Just Heading class of 1913.

What part the factor of acclimitization plays here we have no way of determining.Some claim that it takes a plant three years to reach an equilibrium after being taken to a new climate.Yet it seems to me that all the oats in the experiment probably were affected in the same way.At any rate it is significant that two day segregations were obtained in two places so far apart and under different conditios.

CONCLUSIONS.

1.These oats,with the exception of accession 112,are natural crosses.

2.All of these oats segregate in regard to ripeness.

3.The period between these segregations is 2 days.(This was found in two places 2500 miles apart.)

4.The segregations are according to Mendelian ratios.

5.Factors for ripeness are present.The number in the different oats may vary,but in the progeny of the plats from accession 112,the data shows the presence of one factor in some cases,and two in others. the ratios obtained in this case are comparable with obtained by East and Hays in their study of color

factors in corn.

6.Ripeness is dominant over lateness.In most cases the dominance is incomplete,but in the progeny of accession 112,the ratios indicate complete dominance.

7.It is possible by selection to isolate types which ripen at different times.(From the 1913 data types were obtained which ripened on 3 or 4 dates about one week apart.)The 1914 data indicates that an almost unlimited number of types may be obtained from this material.

8.These types when isolated will be of commercial importance in a state which has such a variation in the length of growing season as Michigan.

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