Bulletin 249 October, 1918

The Agricultural Experiment Station

OF THE

Colorado Agricultural College

MENDELIAN INHERITANCE IN WHEAT AND BARLEY CROSSES

With Probable Error Studies On Class Frequencies

BY

ALVIN KEZER and BREEZE BOYACK

PUBLISHED BY THE EXPERIMENT STATION

FORT COLLINS, COLORADO

1 9 1 8

The Colorado Agricultural College

FORT COLLINS, COLORADO

THE STATE BOARD OF AGRICULTURE

		Term Expires
HON. CHAS. PEARSON	Durango,	1919
HON. R. W. CORWIN	Pueblo,	1919
HON. A. A. EDWARDS, President of the Board	Fort Collins,	1921
Hon. J. S. CALKINS	Westminster,	1921
HON. H. D. PARKER	Greeley,	1923
MRS. AGNES L. RIDDLE	Denver,	1923
HON. J. C. BELL	Montrose,	1925
HON. E. M. AMMONS	Denver,	1925

PRESIDENT CHAS. A. LORY, }
GOVERNOR JULIUS C. GUNTER } Ex-officio

L. M. TAYLOR, Secretary — CHAS. H. SHELDON, Treasurer

EXECUTIVE COMMITTEE

A. A. EDWARDS, Chairman

E. M. AMMONS — H. D. PARKER

OFFICERS OF THE EXPERIMENT STATION

CHAS. A. LORY, M.S., LL.D., D.Sc.	President
C. P. GILLETTE, M.S., D.Sc.	Director
LD CRAIN, B.M.E., M.M.E.	Vice Director
L. M. TAYLOR	Secretary
MABEL LEWIS	Executive Clerk

STATION STAFF

Agricultural Division

C. P. GILLETTE, M.S., D.Sc., Director	Entomologist
W. P. HEADDEN, A.M., Ph.D.	Chemist
G. H. GLOVER, M.S., D.V.M.	Veterinarian
W. G. SACKETT, Ph. D.	Bacteriologist
ALVIN KEZER, A.M.	Agronomist
G. E. MORTON, B.S.A., M.S.	Animal Husbandman
E. P. SANDSTEN, M.S., Ph.D.	Horticulturist
B. O. LONGYEAR, B.S.	Assistant in Forestry
I. E. NEWSOM, B.S., D.V.S.	Veterinary Pathologist
W. W. ROBBINS, M.A., Ph.D.	Botanist
INGA M. K. ALLISON, E.B.	Home Economics
DAVID D. GRAY, B.S.A., U. S. Expert-in-Charge	Horse Breeding
RALPH L. CROSMAN	Editor
R. E. TRIMBLE, B.S.	Assistant in Irrigation Investigations
EARL DOUGLAS, M.S.	Assistant in Chemistry
S. ARTHUR JOHNSON, M.S.	Assistant in Entomology
P. K. BLINN, B.S., Rocky Ford	Alfalfa Investigations
L. C. BRAGG	Assistant in Entomology
MIRIAM A. PALMER, M.A.	Delineator
J. W. ADAMS, B.S., Cheyenne Wells	Assistant in Agronomy, Dry Farming
RALPH L. PARSHALL, B.S., U. S. Irrigation Engineer	Irrigation Investigations
*R. A. McGINTY, B.S.	Assistant in Horticulture
BREEZE BOYACK, B.A., M.S.	Assistant in Agronomy
CHAS. R. JONES, B.S.	Assistant in Entomology
GEO. M. LIST, B.S.	Assistant in Entomology
†CARL ROHWER, B.S., C.E.	Assistant in Irrigation Investigations
R. G. HEMPHILL, B.S.	Assistant in Irrigation Investigations
†THOS. H. McCARTHY, B.S., C.E.	Assistant in Irrigation Investigations
CHAS. I. BRAY, B.S.A., M.S.	Assistant in Animal Husbandry
†H. E. VASEY, A.M.	Assistant in Botany
EVELYN G. HALLIDAY, B.S.	Assistant in Home Economics
THOMAS L. DOYLE	Assistant in Irrigation Investigations
G. E. EGGINTON, B.S.	Seed Analyst
WM. MAY	Assistant in Botany
LETO M. MERKER, G.N.	Assistant in Bacteriology
DON W. STUVER, B.S., C.E.	Assistant in Irrigation Investigations

Engineering Division

LD CRAIN, B.M.E., M.M.E., Chairman	Mechanical Engineering
E. B. HOUSE, B.S., (E.E.), M.S.	Civil and Irrigation Engineering
L. S. FOLTZ, B.S., (E.E.), M.S.	Electrical Engineering

*On leave of absence.
†In their country's service; on leave of absence for duration of the war.

Table of Contents

MENDELIAN INHERITANCE IN WHEAT AND BARLEY CROSSES

With Probable Error Studies on Class Frequencies

By ALVIN KEZER and BREEZE BOYACK

The crosses and their Mendelian behaviour discussed herein were made to furnish material for certain studies in correlation. The Agronomy Section has been and is studying correlation of characters in small grains. The question, Do specific characters follow the same laws or biometric relationships in hybrid progenies that obtain in mixed pure line and straight pure line progenies? arose. Accordingly, in 1911, crosses were made between various wheat varieties, wheat and emmer, and between several barley varieties[1]. In addition to furnishing the Mendelian data, some of the progenies have given rise to new varieties which give promise of being superior to existing adapted sorts. It is quite possible that these secondary lines of study are going to prove of greater value than the original, primary object.

In presenting these data the following order of treatment has been decided upon:

(1) The crosses, where F_1 behaviour and F_2 segregations are described, followed by a description of the F_3 behaviour of certain progenies which were continued into the F_3 generation.

(2) The material has been subjected to a theoretical analysis showing the error limits of Mendelian class frequencies and the conformity of the material thereto.

WHEAT HYBRIDS

The crosses or hybrids described were made in the field the summer of 1911. The methods of handling the heads in making the crosses were the standard methods usually employed by agronomists and plant breeders. The heads to be crossed were first trimmed down to a small number of spikelets by cutting out the undesired spikelets with fine pointed dissection scissors. The middle florets of the spikelets were then pulled out by means of fine pointed forceps, leaving only six or eight spikelets on a head and only the outer or two lateral florets of each spikelet. Before the pollen was fully matured, the florets in the spikelets were emasculated by remov-

[1] The first pollinations were made in 1911 by Professor D. W. Frear, who also made the F_1 notes. The F_2 and subsequent generations were under the observation of Mr. Breeze Boyack.

ing anthers with fine pointed forceps. After the anthers were removed, ripe anthers were placed in the flowers and squeezed so as to liberate the pollen. After each flower had been treated in this way, the entire head was covered with tissue paper to prevent the ingress of undesired pollen. Each head was tagged with a properly numbered tag. The tags and tissue paper were allowed to remain upon the heads until harvest. At that time the heads, tags and all, were collected and placed in envelopes for laboratory study. In this first lot forty-six distinct heads were handled. All of these did not mature seeds so as to give rise to progeny. Only a part of those crosses which gave rise to progeny are discussed at this time.

Six Turkey Red-Harvest King crosses were made, two of which were reciprocal. One cross, Harvest King-Fultz Mediterranean (smooth chaff), and another, Harvest King-Fultz Mediterranean (velvet chaff), were made. Three crosses were made with Turkey Red and Fultz Mediterranean and two crosses with Fultz Mediterranean and Black Winter Emmer. Since this work was not originally designed to make an exhaustive Mendelian study, only a few characters were at first observed. More extensive studies have later been made. Extensive descriptions used will be largely limited to a description of the specific characters under observation. Turkey Red is a well-known variety of Russian origin. It has white chaff, strong beards, a rather short, spindle shaped head with spikelets set rather closely. The seed is rather long, hard, corneous, and red or amber in color. Harvest King is a winter wheat, maturing in a somewhat longer season than Turkey. The head is much larger, not quite so compactly put together, beardless, red chaffed, and the grain is proportionately shorter in its longer axis than Turkey Red, somewhat softer, and with a pronounced coloration.

The origin of Harvest King is not known. But in the opinion of the authors it is probably identical with the original Fultz of Mifflin County, Pennsylvania. The Fultz Mediterranean wheat used in these experiments is evidently of hybrid origin, probably tracing back to the well-known Fultz and Mediterranean as parents. That it is hybrid in origin is indicated by the behaviour of some of the progenies in the F_3 generation. In one of these progenies of a Fultz Mediterranean cross, where both parents are beardless, a bearded form appeared in the F_3 generation which split up according to Mendelian ratios. This bearded form combined in character combinations according to Mendelian ratios, which gives further indication of hybrid origin. Another indication is that a portion of the plants in our present Fultz Mediterranean stock are smooth chaffed. Some are velvet chaffed. Differences in head shape occur which can be accounted for by the hypothesis that the Fultz Mediterranean is of hybrid origin. Two types of Fultz Mediterranean were used in these crosses, both the smooth chaffed and the velvet chaffed.

THE CROSS

Harvest King♀ × Fultz Mediterranean♂
(red chaff) (white chaff)

F_1 Generation

All beardless; red chaff

In this cross red is dominant over white. In the F_2 generation splitting takes place, as shown in Table 1.

TABLE 1

F_2 Distribution of cross 15
Harvest King♀ × Fultz Mediterranean♂
(red chaff) (white chaff)

	Red Chaff	White Chaff
F_2 Distribution From F_1 Plant 15-1	21	5
F_2 Distribution From F_1 Plant 15-2	27	10
F_2 Distribution From F_1 Plant 15-3	22	6
F_2 Distribution From F_1 Plant 15-4	2	2
F_2 Distribution From F_1 Plant 15-5	5	0
Shattered F_1 Grains	9	0
Actual F_2 Distribution Cross 15	**86**	**23**
Expectation on 3:1 Basis	83	26

It will be seen that the actual distribution follows the theoretical expectation quite closely. The theoretical agreement is discussed later in this paper. It will be given further attention at that point.

It has already been mentioned that the Fultz Mediterranean was undoubtedly of hybrid origin, and that both smooth chaffed and velvet chaffed individuals occur in the progenies. Cross Number 16 was made between Harvest King and a velvet chaffed Fultz Mediterranean parent. The F_1 behaviour of this cross was as follows:

Harvest King♀ × Fultz Mediterranean♂
(red and smooth chaff) (white and velvet chaff)

F_1 Generation

The entire progeny red and velvet chaffed

Redness and the velvet character are both dominant. Whiteness and smoothness are recessive. In this cross we have a dihybrid which breaks up in the F_2 generation according to Table 2.

TABLE 2

F_2 Distribution of Cross 16

Harvest King♀ × Fultz Mediterranean♂
(red and smooth chaff) (white and velvet chaff)

	Red and Velvet Chaff	Red and Smooth Chaff	White and Velvet Chaff	White and Smooth Chaff
F_2 Distribution From F_1 Plant 16-1...	16	3	4	1
F_2 Distribution From F_1 Plant 16-2...	28	8	7	1
F_2 Distribution From F_1 Plant 16-3...	29	8	4	2
Actual F_2 Distribution Cross 16	73	19	15	4
Expectation on 9:3:3:1 Basis	62	21	21	7

When we take up crosses with Turkey Red, a new characteristic appears which is worth some consideration at this point. Turkey Red is a bearded wheat. In crosses of bearded wheat with beardless the F_1 generation always gives a great reduction in beard length, but some beards remain. This appearance has been called intermediate. The progeny in this cross does not exhibit true dominance, but a heterozygous form occurs which may usually be told by its appearance. In the F_1 generation this form always appears. True dominance does not exist. In the F_2 generation the progenies break up into one pure beardless, two heterozygous beardless, and one true bearded. The heterozygous beardless individuals may usually be determined by inspection because of the short tipbeards. Occasionally, however, a worker will misjudge the heterozygous and the true beardless. For convenience in this discussion beardlessness has been considered dominant, recognizing the fact that there is one true beardless individual and two heterozygous beardless individuals, which may usually be told upon inspection. The tables have been prepared on the basis of beardless, a dominant character, whereas in fact, it is not truly dominant. However, the progenies lend themselves to this treatment very well.

THE CROSS

Turkey Red♀ × Fultz Mediterranean♂
(bearded) (beardless)
behaves as follows:

F_1 Generation

All individuals intermediate or heterozygous with respect to beardless character

The F_2 generation breaks up according to Table 3. It must be remembered in studying Table 3 that approximately one-third of the individuals called beardless are true beardless, and approximately two-thirds are intermediates or heterozygous and may be determined upon inspection in most cases.

TABLE 3

F_2 Distribution of Cross 22
Turkey Red♀ × Fultz Mediterranean♂
(bearded) (beardless)

	Beardless	Bearded
F_2 Distribution From F_1 Plant 22-1..........	82	33
F_2 Distribution From F_1 Plant 22-2..........	24	9
F_2 Distribution From F_1 Plant 22-3..........	49	18
F_2 Distribution From F_1 Plant 22-4..........	19	11
F_2 Distribution From F_1 Plant 22-5..........	30	6
F_2 Distribution From F_1 Plant 22-6..........	44	18
F_2 Distribution From F_1 Plant 22-7..........	23	2
F_2 Distribution From F_1 Plant 22-8..........	16	3
F_2 Distribution From F_1 Plant 22-9..........	13	6
F_2 Distribution From F_1 Plant 22-11..........	9	3
F_2 Distribution From F_1 Plant 22-12..........	45	12
F_2 Distribution From F_1 Plant 22-13..........	44	16
F_2 Distribution From F_1 Plant 22-14..........	7	2
Shattered F_1 Grains..........................	23	12
Actual F_2 Distribution Cross 22..............	428	151
Expectation on 3:1 Basis......................	435	145

Table 4 and Table 5 represent progenies of similar crosses.

TABLE 4

F_3 Distribution of Cross 23
Turkey Red♀ × Fultz Mediterranean♂
(bearded) (beardless)

	Beardless	Bearded
F_2 Distribution From F_1 Plant 23-1..........	29	11
F_2 Distribution From F_1 Plant 23-2..........	19	4
F_2 Distribution From F_1 Plant 23-3..........	8	3
F_2 Distribution From F_1 Plant 23-4..........	29	9
F_2 Distribution From F_1 Plant 23-5..........	42	15
F_2 Distribution From F_1 Plant 23-6..........	40	22
F_2 Distribution From F_1 Plant 23-7..........	50	24
F_2 Distribution From F_1 Plant 23-8..........	38	9
F_2 Distribution From F_1 Plant 23-9..........	53	20
F_2 Distribution From F_1 Plant 23-10..........	61	29
F_2 Distribution From F_1 Plant 23-11..........	62	25
Shattered F_1 Grains..........................	121	41
Actual F_2 Distribution Cross 23..............	552	212
Expectation on 3:1 Basis......................	573	191

TABLE 5

F_2 Distribution of Cross 24
Turkey Red♀ × Fultz Mediterranean♂
(bearded) (beardless)

	Beardless	Bearded
F_2 Distribution From F_1 Plant 24-1	170	41
F_2 Distribution From F_1 Plant 24-2	49	19
F_2 Distribution From F_1 Plant 24-3	48	21
F_2 Distribution From F_1 Plant 24-4	110	46
F_2 Distribution From F_1 Plant 24-5	62	24
F_2 Distribution From F_1 Plant 24-6	55	23
F_2 Distribution From F_1 Plant 24-7	85	23
F_2 Distribution From F_1 Plant 24-8	103	34
F_2 Distribution From F_1 Plant 24-9	40	14
F_2 Distribution From F_1 Plant 24-10	27	10
F_2 Distribution From F_1 Plant 24-11	23	7
F_2 Distribution From F_1 Plant 24-12	60	23
F_2 Distribution From F_1 Plant 24-13	31	16
Shattered F_1 Grains	11	4
Actual F_2 Distribution Cross 24	874	305
Expectation on 3:1 Basis	884	295

These distributions have been summarized in Table 6.

TABLE 6

Summary of Crosses 22, 23, and 24
Turkey Red♀ × Fultz Mediterranean♂
(bearded) (beardless)

	Beardless	Bearded
Actual F_2 Distribution Cross 22	428	151
Actual F_2 Distribution Cross 23	552	212
Actual F_2 Distribution Cross 24	874	305
Actual F_2 Distribution Summary	1,854	668
Expectation on a 3:1 Basis	1,892	631

When we introduce another pair of characters, a dihybrid is secured. This is accomplished by making the cross between Harvest King, a red chaffed, beardless, wheat, and Turkey Red, a white chaffed, bearded wheat. Here the red color is partially dominant over white, so that the F_1 generation individuals are always red chaffed. But the red secured in the hybrid differs from the red of the Harvest King parent, that is, it is heterozygous red which may usually be determined upon inspection. But if we consider all red chaffed individuals, we can throw them into a dominant class, one-third of which will be true reds and two-thirds heterozygous reds. The white, however, behaves as a true recessive. The heterozygous red breaks up in the F_2 generation, giving rise to pure reds, heterozygous reds, and pure white according to Mendelian ratios. If we consider these two characters, each of which behaves as a partial dominant and not as a true dominant, we get a dihybrid cross.

THE DIHYBRID CROSS

Harvest King♀ × Turkey Red♂

(red chaffed: beardless) (white chaffed: bearded)

F_1 Generation

All beardless and red chaffed

Both the red chaffed color and the beardless are heterozygous or intermediates. In the F_2 generation the hybrid breaks up into red chaffed beardless, white chaffed beardless, red chaffed bearded, white chaffed bearded in the proportion of 9:3:3:1, as shown by the data in Tables 7 and 8. When the bearded, white form occurs, it breeds true thereafter. Regular proportions of the 9 and 3 classes continue to split and recombine.

TABLE 7

F_2 Distribution of Cross 11

Harvest King♀ × Turkey Red♂

(red chaffed; beardless) (white chaffed; bearded)

	Beardless Red Chaff	Beardless White Chaff	Bearded Red Chaff	Bearded White Chaff
F_2 Distribution From F_1 Plant 11-1...	27	7	12	3
F_2 Distribution From F_1 Plant 11-2...	52	25	21	8
Actual F_2 Distribution Cross 11	79	32	33	11
Expectation on 9:3:3:1 Basis	86	29	29	10

TABLE 8

F_2 Distribution of Cross 13

Harvest King♀ × Turkey Red♂

(red chaffed; beardless) (white chaffed; bearded)

	Beardless Red Chaff	Beardless White Chaff	Bearded Red Chaff	Bearded White Chaff
F_2 Distribution From F_1 Plant 13-1...	24	12	8	5
F_2 Distribution From F_1 Plant 13-2...	51	27	30	6
F_2 Distribution From F_1 Plant 13-3...	53	21	20	6
F_2 Distribution From F_1 Plant 13-4...	20	4	5	1
F_2 Distribution From F_1 Plant 13-5...	12	1	5	1
Shattered F_1 Grains.......	9	4	4	0
Actual F_2 Distribution Cross 13	169	69	72	19
Expectation on 9:3:3:1 Basis	185	62	62	20

The data in Tables 9, 10, 11, and 12 represent the same parentage as Tables 7 and 8, but in the reciprocal cross. The distribution of the progenies and their Mendelian behaviour occurs in the same manner in the cross and its reciprocal, as is evidenced in the summaries of the cross and its reciprocal in Table 13. In Table 14 the cross and the reciprocals are summarized, which gives an additional amount of data, the sum of the two distributions.

TABLE 9

F_2 Distribution of Cross 18

Turkey Red♀ × Harvest King♂

(white chaffed; bearded) (red chaffed; beardless)

	Beardless Red Chaff	Beardless White Chaff	Bearded Red Chaff	Bearded White Chaff
F_2 Distribution From F_1 Plant 18-1...	4	4	2	0
Actual F_2 Distribution Cross 18	4	4	2	0
Expectation on 9:3:3:1 Basis	6	2	2	1

TABLE 10

F_2 Distribution of Cross 19

Turkey Red♀ × Harvest King♂

(white chaffed; bearded) (red chaffed; beardless)

	Beardless Red Chaff	Beardless White Chaff	Bearded Red Chaff	Bearded White Chaff
F_2 Distribution From F_1 Plant 19-1...	30	10	17	6
F_2 Distribution From F_1 Plant 19-2...	91	15	22	7
F_2 Distribution From F_1 Plant 19-3...	56	10	24	4
F_2 Distribution From F_1 Plant 19-4...	13	5	9	2
F_2 Distribution From F_1 Plant 19-5...	43	15	17	3
F_2 Distribution From F_1 Plant 19-6...	6	6	4	3
F_2 Distribution From F_1 Plant 19-7...	43	11	16	2
F_2 Distribution From F_1 Plant 19-8...	33	8	16	2
Shattered F_1 Grains.......	34	12	9	5
Actual F_2 Distribution Cross 19	349	92	134	34
Expectation on 9:3:3:1 Basis	342	114	114	38

TABLE 11

F_2 Distribution of Cross 20
Turkey Red♀ × Harvest King♂
(white chaffed; bearded) (red chaffed; beardless)

	Beardless Red Chaff	Beardless White Chaff	Bearded Red Chaff	Bearded White Chaff
F_2 Distribution From F_1 Plant 20-1...	17	3	8	4
Actual F_2 Distribution Cross 20	17	3	8	4
Expectation on 9:3:3:1 Basis	19	6	6	2

TABLE 12

F_2 Distribution of Cross 21
Turkey Red♀ × Harvest King♂
(white chaffed; bearded) (red chaffed; beardless)

	Beardless Red Chaff	Beardless White Chaff	Bearded Red Chaff	Bearded White Chaff
F_2 Distribution From F_1 Plant 21-1...	61	20	22	7
F_2 Distribution From F_1 Plant 21-2...	45	21	16	6
F_2 Distribution From F_1 Plant 21-3...	65	18	22	6
F_2 Distribution From F_1 Plant 21-4...	32	8	7	2
F_2 Distribution From F_1 Plant 21-5...	22	7	13	6
Shattered F_1 Grains.......	9	8	4	3
Actual F_2 Distribution Cross 21	234	82	84	30
Expectation on 9:3:3:1 Basis	242	81	81	27

TABLE 13

Summary of Crosses 11 and 13
Harvest King♀ × Turkey Red♂
(red chaffed; beardless) (white chaffed; bearded)

	Beardless Red Chaff	Beardless White Chaff	Bearded Red Chaff	Bearded White Chaff
Actual F_2 Distribution Cross 11	77	32	33	11
Actual F_2 Distribution Cross 13	169	69	72	19
Actual F_2 Distribution Summary	246	101	105	30
Expectation on 9:3:3:1 Basis	271	90	90	30

TABLE 13 (Continued))

Summary of Crosses 18, 19, 20, and 21
Turkey Red♀ × Harvest King♂
(white chaffed; bearded) (red chaffed; beardless)

	Beardless Red Chaff	Beardless White Chaff	Bearded Red Chaff	Bearded White Chaff
Actual F_2 Distribution Cross 18	4	4	2	0
Actual F_2 Distribution Cross 19	349	92	134	34
Actual F_2 Distribution Cross 20	17	3	8	4
Actual F_2 Distribution Cross 21	234	82	84	30
Actual F_2 Distribution Summary	604	181	228	68
Expectation on 9:3:3:1 Basis	608	203	203	68

TABLE 14

Summary of Reciprocal Crosses
(11-13)—(18-19-20-21)

	Beardless Red Chaff	Beardless White Chaff	Bearded Red Chaff	Bearded White Chaff
Actual F_2 Distribution Harvest King × Turkey Red	246	101	105	30
Actual F_2 Distribution Turkey Red × Harvest King	604	181	228	68
Actual F_2 Distribution Summary	850	282	333	98
Expectation on 9:3:3:1 Basis	879	293	293	98

The crosses which have just been enumerated represent botanically closely related varieties. When one parent botanically more distant in relationship is introduced, as is done in making the Fultz Mediterranean-Black Winter Emmer cross, a number of striking new things arise. Fultz Mediterranean, which was used as a parent in this case, happened to be a type which evidenced some club attributes in that the tip of the spike was somewhat compressed, closely resembling club form. The chaff was white, the spikelets regular and beardless, not keeled, and chaff comparatively soft, adhering very loosely to the grain. Black Winter Emmer, on the other hand, has a flat, two-row, compressed head. The color is black. The chaff is keeled, hard, and tenacious, sticking very tightly to the kernel. The beards are long and prominently barbed. The chaff in Black Winter Emmer is always covered with short, stiff hairs. The hairs are too stiff to be properly called velvet. In addition the exterior of the glumes in the typical emmer is covered with a substance which gives an appearance which may best be described by calling it bloom. Thus it is seen that the two parents are radically different. Further differences than are brought out here may be presented in a later publication.

THE CROSS

Fultz Mediterranean♀	×	Black Winter Emmer♂
(semi-club, white chaff, regular spikelets, bearded, chaff shatters, not keeled, chaff not covered with bloom, smooth chaff)		(two-row, black, keeled, bearded, adherent chaff, chaff covered with bloom, stiff hairy chaff)

behaves as follows:

F_1 Generation

All individuals heterozygous black, chaff stiff hairy, heterozygous beardless, two-row, flat, keeled, chaff not bloomed, hard adherent chaff

The black in this case was not a pure black but is what might be called a mulatto black. The black of the emmer parent is a deep black, perhaps best described as a purple black. All of the F_1 progeny have short beards, but the beards are neither as coarse, as long, or as heavily barbed as the emmer parent. For that reason they have been termed intermediate or heterozygous beards. When the F_1 seeds are planted, giving rise to the F_2 generation, from sixty-three to sixty-five distinct forms, no two of them alike, occur in the progenies of the two crosses studied (crosses 9 and 10). Whether other forms would arise or not cannot be determined in our experiments owing to an insufficient number of plants in the F_2 generation.

At the first glance this material appears to be without any particular order or reason. A study, however, of the black character shows that this character follows the Mendelian laws in its transmission, as do the bearded and beardless characters, the hard and soft chaff, the flat and regular head. Yet many new shapes appear among the heads of the progenies which are apparently in no way related to the head shapes of either parent insofar as our present analysis goes. The hairy character is always associated with the black in all the progenies. Evidently these two are correlated or linked, as all blacks, no matter of what shape, no matter what the character of the glume, are hairy, while the whites and browns, which occur as chaff colors, never have this hairy appearance. If hairiness and blackness are two separate characters, they have always been transmitted together. Whether this constitutes a true case of linkage or whether it constitutes a case of correlation is not known. The fact remains that the characters are associated and transmitted together in the same way as a simple unit character. Further study is being made on new material. Some of the forms which appear in head shape give rise to long, loose-jointed rachises. Some are close and compact, some clubbed, some intermediate. Some have branching spikelets, giving rise to the appearance commonly called many-headed. Some have sterile florets. Some resemble spelt, some wheat, some emmer. In spite of the fact that red is not visible in the chaff color of either parent, brown and red chaff individuals arise. The deep purple black of the Black Winter Emmer is absent in practically all of the blacks, altho it occasionally appears. Certain of these head forms are always self sterile. These have been designated as mules. Of course, when a so-called mule type appears, it is self limited, as it does not propagate. Since this material is being subjected to a somewhat different line of study, further discussion in this paper is limited to the discussions in connection with illustrations.

BARLEY CROSSES

Barley as well as wheat is self fertile, so that in both wheat and barley the F_1 generation and subsequent generations are selfed without the necessity of any effort on the part of the plant breeder. Barley is even more certainly self fertile than wheat, as the anthers become ripe and burst, producing fertilization in most cases before the head is out of the sheath. In making barley crosses this habit has to be recognized in order to catch the stigmas and anthers at the proper state of maturity. Usually it is necessary to cut open the sheath to get at the head for hand pollination. Otherwise the head treatment for hand pollination is essentially the same for barleys as has already been described for wheats. Barleys offer a large number of easily detected unit characters for study. Altho we have studies under way including five or more character pairs, studies on three character pairs only will be presented at this time, which will illustrate the behaviour in the monohybrid, dihybrid, and trihybrid distributions. The object in making the barley crosses was in part the same as that which governed the making of wheat crosses. In addition it was hoped that there might be obtained forms adapted to many of Colorado's special high altitude conditions where good yield, good feeding quality, and early maturity are all characteristics of importance.

California, called by the Bureau of Plant Industry "Coast", a six-row, white chaffed, bearded barley, a barley somewhat coarse in habits of growth and in matured grain, but one maturing in a medium early season and having the ability to produce very heavily, was used as one of the parents. A barley which was known as Beardless and so appears in our accession books was used as another. This so-called Beardless barley is a hulled, hooded, six-row type.

F_1 Behaviour of the Cross
California♀ × Hooded♂
Progenies hooded
Hooded is dominant, beards recessive

TABLE 15

F_2 Distribution of Crosses 30 and 31
California♀ × Hooded♂
(bearded) (hooded)

	Hooded	Bearded
Actual F_2 Distribution Cross 30	1,402	432
Expectation on a 3:1 Basis	1,376	458
Actual F_2 Distribution Cross 31	1,271	453
Expectation on a 3:1 Basis	1,293	431
Summary of Crosses 30 and 31		
Actual F_2 Distribution	2,673	885
Expectation on a 3:1 Basis	2,669	889

A cross was also made between California and a variety called Black Hulled. Black Hulled is black hulled and two-rowed. The Black Hulled barley also had the quality of maturing in a very short season. This short season character, however, will not be discussed in this connection.

THE CROSS
California♀ × Black Hulled♂
F_1 Generation
All individuals two-rowed, black hulled

The F_2 generation breaks up as a dihybrid as shown in Table 16.

TABLE 16

F_2 Distribution of the Dihybrid Cross 32
California♀ × Black Hulled♂
(white hulled) (black hulled)
(six-row; bearded) (two-row; bearded)

	Black Hulled 2-row	Black Hulled 6-row	White Hulled 2-row	White Hulled 6-row
Actual F_2 Distribution Cross 32	1,167	417	378	127
Expectation on 9:3:3:1 Basis	1,175	392	392	131

When we combine Black Hulled with the hooded variety Beardless, a third character pair is introduced, namely, hooded and beards. The black hulled, two-row, hooded characters are dominant, and white hulled, six-row, bearded are recessive. Consequently

THE CROSS

Black Hulled♀ × Hooded♂
(black hulled, two-rowed, bearded) (white hulled, six-rowed, hooded)

gives rise to an F_1 generation as follows: All individuals black, two-rowed, and hooded. The F_2 generation breaks up according to Table 17.

TABLE 17

F_2 Distribution of the Trihybrid Crosses 36, 37, and 38
Black Hulled♀ × Hooded♂
(black hulled) (white hulled)
(two-rowed; bearded) (six-rowed; hooded)

	Hooded Black 2-row	Hooded Black 6-row	Hooded White 2-row	Hooded White 6-row	Bearded Black 2-row	Bearded Black 6-row	Bearded White 2-row	Bearded White 6-row
Actual F_2 Distribution Cross 36	133	48	42	14	47	19	13	4
Expectation on 27:9:9:9:3:3:3:1 Basis..........	135	45	45	15	45	15	15	5
Actual F_2 Distribution Cross 37....	133	42	35	15	39	11	9	6
Expectation on 27:9:9:9:3:3:3:1 Basis.........	122	41	41	14	41	14	14	5
Actual F_2 Distribution Cross 38....	327	96	114	28	99	39	36	14
Expectation on 27:9:9:9:3:3:3:1 Basis.........	318	106	106	35	106	35	35	12
Actual F_2 Distribution Summary ..	593	186	191	57	185	69	58	24
Expectation on 27:9:9:9:3:3:3:1 Basis.........	575	192	192	64	192	64	64	21

From this trihybrid cross a two-rowed, hooded barley has been evolved which is now being grown in the field. The creation of hooded or beardless types of barley for Colorado conditions has an exceedingly strong practical as well as theoretical interest because of the value of such forms for feeding purposes, for the production of barley pastures, or pastures of barley in combination with peas, and for the production of barley hays. As a consequence the production of desirable hooded types is being given considerable study with the idea of their possible practical use. Sufficient progress has already been made to warrant the belief that varieties may be created having the desired characteristics for all these practical purposes and for many others not enumerated here. Barley in much of our agriculture takes the place in our feeding operations which corn takes in the corn belt, because barley may be produced profitably at altitudes far higher than any in which corn can possibly be raised. In addition, barley furnishes a good feed in these altitudes in quantities much in excess of many other crops, and in some localities where corn may be grown, barley will produce more pounds of digestible food per acre than will corn. Thus it becomes increasingly important to produce varieties adapted to the various situations.

The cross between California or Coast, a six-rowed, bearded barley already described, and Hanna, a two-rowed, bearded barley, has brought out some points worthy of mention at this time. In this case a true dominant with respect to beards does not exist. A heterozygous form appears in the F_1 generation which might be called intermediate, but which perhaps is better described as simply heterozygous. The F_1 generation has six rows of kernels much the same as the Coast parent but only two rows of beards. The central row of kernels is bearded, the lateral rows not bearded or have very short beards. These lateral grains appear in various degrees of development. In some cases only a few lateral grains are developed on the head. The variation in development ranges from these few lateral grains to a complete supply of lateral grains or the fully developed stage. Wherever these heterozygous or intermediate forms occur, even tho only one row of the lateral kernels is developed, the F_2 progeny splits up into pure six-rowed, pure two-rowed, and heterozygous six-rowed. Wherever the two-row occurs, it breeds true. Wherever the six-row occurs, it breeds true. This development seems to be peculiar to certain barley crosses and is not common to all. The same characteristic does not appear in the cases of crosses between Coast and the two-rowed Black Hulled. Some workers have called this intermediate form *Hordeum intermedium*, implying that Hordeum intermedium has been fixed from some of the progenies of a similar cross to that of Coast by Hanna. Harry V. Harlan, in Bulletin No. 622, Bureau of Plant Industry, page 13, says:

"In the six-rowed barleys all awnless forms are thrown into intermedium. The awnless character is most probably of hybrid origin, and in all six-rowed awnless varieties now known there is a tendency in some strains to produce short awns on the central spikelets when grown under especially favorable conditions, indicating a direct relationship with intermedium. It may be found necessary to include awnless sorts under Hordeum vulgare as well, but at present it seems better to list these forms with the intermedium.

"Of the varieties and subvarieties which follow, a large number are of hybrid origin. The species intermedium probably consists entirely of hybrid varieties. In the beginning it was attempted to separate the known hybrid varieties from those occurring naturally. However, there seems no good reason for such a distinction, for many of the varieties which are not known to be hybrid probably have arisen from accidental crossing."

This does not appear to be the case in the instance of the cross just described. The intermediate form is heterozygous. The intermediate form does not occur in certain of them. Wherever it does occur in our work, the intermediate form has been heterozygous without a single exception.

It is quite possible, as Harlan indicates, that *Hordeum intermedium* is of hybrid origin. It so happens, however, that in the material with which we have worked it has been impossible to fix this intermediate form altho it occurs in certain crosses, always occurring in the Coast by Hanna cross or its reciprocal. But in its occurrence it is always heterozygous. Consequently we have never been able to fix this form. The material which we have handled has not been sufficient to warrant any general statements with respect to fixing the intermediate form. In view of the generally prevailing opinion that this form is of hybrid origin, it is interesting to note that in our set of materials the *intermedium* occurs but is always heterozygous and consequently cannot be fixed.

BEHAVIOUR IN F_3 GENERATION

A great many of the crosses reported herein were carried from the F_2 to the F_3 and subsequent generations. It was impossible to carry all progenies because of the number involved. In any work of this kind the numbers in the F_2 and subsequent generations soon get so large that it becomes physically impossible to handle all of the populations. Accordingly random samples were taken from each class of the F_2 generation to carry into the F_3 generation for behaviour tests. One idea behind this work was to test possible desirable strains. A second idea was to test the possibility of increasing homozygousness. It is recognized that the ability to increase homozygousness increases the possibility of fixing and continuing desirable strains. According to the accepted theory a monohybrid breaks up in the F_2 generation into two possible classes, one of which is represented by three individuals which we may call the Three Class, and the other is represented by one individual which we may call the One Class. Theoretically, when these are taken to the F_3 generation, one individual of the Three Class is homozygous and breeds true. The other two individuals are heterozygous and split according to Mendelian ratios in the F_4 generation. In a like manner a dihybrid represents four possibilities, the first of which is represented by nine individuals in one class called the Nine Class, three individuals in two other classes called the Three Classes, and one individual in the last class called the One Class. At least in a dihybrid the smallest number which will fully represent the classes requires sixteen individuals, apportioned as just enumerated. Theoretically, eight of the Nine Class are heterozygous and one homozygous for all characters. Each of the Three Classes is again represented by one homozygous and two heterozygous forms, the One Class breeding true, as it is pure homozygous or recessive. Where the trihybrid is represented, the least number of classes which will satisfy the possibilities is eight, and the least number of individuals which will satisfy the conditions is sixty-four, divided in classes as follows, 27:9:9:9:3:3:3:1. Theoretically, the Twenty-seven Class would break up as follows: Twenty-six individuals heterozygous with respect to some of the characters and one homozygous with respect to all. The Nine Classes would break up as in the dihybrid, giving one homozygous and eight heterozygous forms with respect to some characters. The Three Classes, as in the dihybrid, break up into one homozygous and two heterozygous individuals, the One Class breeding true, as it is pure homozygous or recessive. In other words, in a population having individuals enough to represent completely every class if a trihybrid, the chances of getting a complete homozygous individual would be 1 to 26 in the Twenty-seven Class; 1 to 8 in the Nine Classes; 1 to 2 in the Three Classes; 1 to 1, or absolute, or certainty, in the One Class. We recognize that the tests of F_2 progenies which were carried to the F_3 generation were not complete enough to be absolutely conclusive. But the behaviour is significant. The probable error is discussed in the latter part of this publication, which will indicate the probability of correctness of the work. Accordingly the following summaries of selections from the F_2 generation for F_3 generation plants are presented:

The wheat crosses, 13, 16, 19, and 24, were subjected to field study and laboratory analysis.

Cross 13

Harvest King♀ × Turkey Red♂
(red chaffed: beardless) (white chaffed: bearded)

This cross is presented as a representative of dihybrid behaviour. Accordingly there are four F_2 groups or class combinations as follows:

(1) Beardless and Red Chaff.
53 selections were made,
of which 8 came true. Expectancy 1 in 9
Obtained 1 in 6.6

(2) Beardless and White Chaff.
21 selections were made,
of which 8 came true. Expectancy 1 in 3
Obtained 1 in 2.6

(3) Bearded and Red Chaff.
20 selections were made,
of which 7 came true. Expectancy 1 in 3.
Obtained 1 in 2.9.

(4) This class was supposedly pure and was represented by beards and white chaff, both recessive characters. 6 selections were made, of which 6 came true.

Cross 16

Harvest King♀ × Fultz Mediterranean♂
(red and smooth chaff) (white and velvet chaff)

This dihybrid cross gave rise to four F_2 classes or groups as follows:

(1) Red and Velvet Chaff.
25 selections were made at random,
of which 2 came true. Expectancy 1 in 9
Obtained 1 in 12.5

(2) Red and Smooth Chaff.
8 selections were made,
of which 1 came true. Expectancy 1 in 3
Obtained 1 in 8

(3) White and Velvet Chaff.
7 random selections were made,
of which 2 came true. Expectancy 1 in 3
Obtained 1 in 3.5

(4) White and Smooth Chaff.
This class was supposed to be homozygous. Only 1 selection was made, which, of course, was not enough to test the conditions. But it came true, being a perfect, true homozygous progeny.

Cross 19

Turkey Red♀ × Harvest King♂
(bearded: white chaff) (beardless: red chaff)

This dihybrid was represented by four F_2 classes or groups as follows:

(1) Beardless and Red Chaff.
86 selections were made at random,
of which 13 came true. Expectancy 1 in 9
Obtained 1 in 6.6

(2) Beardless and White Chaff.
20 selections were made,
of which 10 came true. Expectancy 1 in 3
Obtained 1 in 2

(3) Bearded and Red Chaff.
19 selections were made,
of which 9 came true. Expectancy 1 in 3
Obtained 1 in 2.1

(4) Bearded and White Chaff.
10 selections were made,
of which 10 came true. Expectancy 1 in 1
Obtained 1 in 1

Cross 24

Turkey Red♀ × Fultz Mediterranean♂
(bearded) (beardless)

This monohybrid is represented by two groups or classes:

(1) Beardless.
165 random selections were made,
of which 61 came true. Expectancy 1 in 3
Obtained 1 in 2.7

(2) Bearded.
41 random selections were made,
of which 41 came true. Expectancy 1 in 1
Obtained 1 in 1

The barley crosses, 30, 31, 32, and 36, were chosen to represent monohybrid, dihybrid, and trihybrid distributions.

Cross 30

California♀ × Beardless♂
(bearded) (hooded)

This monohybrid is represented by two classes:

(1) Hooded.
76 random selections were made,
of which 24 came true. Expectancy 1 in 3
Obtained 1 in 3.2

(2) Bearded.
5 selections were made,
of which 5 came true. Expectancy 1 in 1
Obtained 1 in 1

Cross 31

California♀ × Beardless♂
(bearded) (hooded)

Two F_2 classes or groups are represented:

(1) Hooded.
78 random selections were made,
of which 27 came true. Expectancy 1 in 3
Obtained 1 in 2.9

(2) Bearded.
5 random selections were made,
of which 5 came true. Expectancy 1 in 1
Obtained 1 in 1

Cross 32

California♀ × Black Hulled♂
(white: six-rowed) (black: two-rowed)

This dihybrid is represented by four classes as follows:

(1) Black Hulled and Two-rowed.
52 random selections were made,
of which 5 came true. Expectancy 1 in 9
Obtained 1 in 10.4

(2) Black Hulled and Six-rowed.
21 selections were made,
of which 8 came true. Expectancy 1 in 3
Obtained 1 in 2.4

(3) White Hulled and Two-rowed.
21 selections were made,
of which 6 came true. Expectancy 1 in 3
Obtained 1 in 3.5

(4) White Hulled and Six-rowed.
6 random selections were made,
of which 6 came true. Expectancy 1 in 1
Obtained 1 in 1

Cross 36

Black Hulled♀ × Beardless♂
(black hulled) (white hulled)
(two-rowed: bearded) (six-rowed: hooded)

This trihybrid cross is represented by eight classes or groups as follows:

(1) Hooded, Black Hulled, and Two-rowed.
128 random selections were made,
of which 6 came true. Expectancy 1 in 27
Obtained 1 in 21.3

(2) Hooded, Black Hulled, and Six-rowed.
52 random selections were made,
of which 9 came true. Expectancy 1 in 9
Obtained 1 in 5.8

(3) Hooded, White Hulled, and Two-rowed.
40 selections were made at random,
of which 7 came true. Expectancy 1 in 9
Obtained 1 in 5.7

(4) Bearded, Black Hulled, and Two-rowed.
46 random selections were made,
of which 6 came true. Expectancy 1 in 9
Obtained 1 in 7.7

(5) Hooded, White Hulled, Six-rowed.
15 selections were made,
of which 6 came true. Expectancy 1 in 3
Obtained 1 in 2.5

(6) Bearded, Black Hulled, Six-rowed.
20 random selections were made,
of which 6 came true. Expectancy 1 in 3
Obtained 1 in 3.3

(7) Bearded, White Hulled, Two-rowed.
13 random selections were made,
of which 5 came true. Expectancy 1 in 3
Obtained 1 in 2.6

(8) Bearded, White Hulled, Six-rowed.
4 random selections were made,
of which 4 came true. Expectancy 1 in 1
Obtained 1 in 1

It will be seen from these brief studies that it is easily possible to fix the homozygous quality in the F_3 generation, provided numbers enough are carried for the purpose. Insofar as any monohybrid, dihybrid, or trihybrid is concerned, it is never necessary (if sufficient numbers are carried) to go beyond the F_3 generation to fix homozygousness in any of the possible classes. Theoretically, the same would be true of tetrahybrids, pentahybrids, and so on. But practically the number of classes and the number of individuals becomes so large where four or more character pairs are represented that it will usually require the use of more generations in order to obtain a sufficient number of individuals to satisfy all of the possibilities, and all of the possibilities must be satisfied if homozygousness is to be of a certainty fixed or established. When homozygousness is established for all characters with which the breeder is operating, a pure type which will breed true thereafter is obtained. The appearance of anomalous and unexplainable forms in hybrids is due to the fact that homozygousness has not been established for some characters.

It is recognized in this work that many characters exist which are not visible. For instance, in the cross previously mentioned, Black Winter Emmer and Fultz Mediterranean, red chaffed individuals occur in the F_2 progeny. Yet red is not visible in either parent. Of course, in a cross of this kind, the highly pigmented winter emmer may have one or more colors hidden by the density of the pigmentation, which produces some particular color. In other words, it is impossible to tell what is under the black of the Black Winter Emmer. Similar possibilities exist for numerous other characters. Sometimes an apparent linkage occurs as in the case of chaff hairs, and black color (if black may be called a color) which are evidently linked.

MATERIAL HANDLED.

All material and data reported in this paper refer to self-fertile groups of plants. Thus all of the progenies of crosses are selfed thru the natural process of fertilization. With the wheats the Turkey Red parent is the well known Turkey Red or Crimean. The Harvest King is a red chaffed, beardless, red berried winter wheat. The grain is only semi-hard to soft. The origin of our material is not definitely known as to variety. The original seed was obtained in 1907 from W. M. Jardine. Our Fultz Mediterranean was obtained at the same time from the same source. From a comparison of samples and descriptions we are of the opinion that the Harvest King is identical with or very similar to the Old Fultz. Our Fultz Mediterranean material was evidently of hybrid origin. This opinion is strengthened by the fact that different forms are constantly appearing in the progenies and that when Harvest King and Fultz are crossed, bearded forms appear in the F_3 generation altho both parents are beardless. This would indicate a bearded parent in the ancestry. Consequently it is thought that this material was hybrid. With the Fultz Mediterranean material there frequently occurred velvet chaffed individuals, and there occasionally occurred individuals having heads tending towards the club appearance but which were still not true clubs. The specific type of variation used is indicated in each instance in the work reported herein. The Black Winter Emmer descended directly from a shipment received from M. A. Carlton of the Bureau of Plant Industry.

For the purposes of this paper four crosses representing monohybrids were taken: Harvest King ♀ (red chaffed) by Fultz Mediterranean♂ (white chaffed) with 109 individuals in the F_2 generation; three crosses of Turkey Red♀(bearded) by Fultz Mediterranean♂ (beardless) represented by the crosses 22, 23, and 24, having 2,522 individuals in the F_2 generation or a total of 2,631 individuals representing two type crosses and four actual crosses. To represent the dihybrid, seven crosses are used: Cross, 16, Harvest King♀ (red chaffed: smooth) by Fultz Mediterranean♂ (white chaffed: velvet); crosses 11 and 13, Harvest King♀ (red chaffed: beardless) by Turkey Red♂ (white chaffed: bearded); crosses 18, 19, 20, and 21, Turkey Red♀ (white chaffed: bearded) by Harvest King♂ (red chaffed: beardless). Cross 16 was represented by 115 individuals in the F_2 generation. Crosses 11 and 13 are reciprocal crosses of 18, 19, 20, and 21. These six crosses are represented by 1,563 individuals or a total of 1,678 in the F_2 population.

As the result of the Turkey Red-Fultz Mediterranean cross a number of exceedingly promising sorts have been originated. These have been carried enough generations to know that the types are fixed, but they have not yet been sufficiently tested to warrant their distribution. They give very great promise, however, of not only being high yielders but also of possessing extremely high quality. The Turkey Red-Harvest King cross has given rise to a number of very high yielding strains, but the quality of the progenies which have been returned was not as high as the Turkey Red♀ by Fultz Mediterranean♂ progenies. It is interesting to note that the progenies which have given very great promise of high farm value all have the Turkey Red shape of berry, altho some of these progenies are quite different from Turkey Red in many respects. Some of them are beardless. The straw characters are different. The head characters are different. Still the type of berry which persists bears a very close resemblance to the Turkey Red shape. Grain factors are being subjected to a different line of study.

Nine crosses are represented in the barley hybrids: two (crosses 30 and 31) California♀ (bearded) by Beardless♂ (hooded) exemplifying the monohybrid condition. These two crosses were represented by 3,558 individuals in the F_2 generation. The dihybrid cross is represented by cross 32, California♀ (white hulled: six-rowed) by Black Hulled♂ (black hulled: two-rowed). This cross was represented by 2,099 individuals in the F_2 generation. Three crosses (36, 37, and 38), Black Hulled♀ (black hulled: two-rowed: bearded) by Beardless♂ (white hulled: six-rowed: hooded) gave rise to 1,363 individuals in the F_2 generation.

The California parent is identical with the so-called California Feed, more properly called Coast. Our stock was originally obtained in 1906 from the Greeley district from a Mr. Neff, a reliable farmer of that section. Our Beardless material came to us under that name, being obtained from a Mr. G. Green. This Beardless is thought to be identical with Success, as it is a hulled, hooded variety of considerable merit. In the tabulations this variety has been referred to as Hooded. This designation was deliberately used to call attention to the hooded appearance. The Black Hulled is of unknown origin. The seed was obtained in 1906. No record persists as to the source of the seed.

It is interesting to note that from the Black Hulled by Beardless cross a two-rowed, hooded form has been established. This form has bred true for several seasons. It gives very great promise of being of value. The California♀-Hanna♂ cross reported herein was represented by three crosses, 34, 35, and 40. It has been described in this paper because of the appearance of the *intermedium* form and the behaviour of this particular characteristic. No record exists as to the source of the Hanna seed. The original strain is still maintained in our nurseries directly descended from the original stock which was obtained by the Experiment Station in 1905. However, this is typical Hanna, commonly grown at many points in the West, being a nodding, two-rowed, bearded type, probably identical with the Hanna described by Carlton.[1]

THE MENDELIAN LAW OF INHERITANCE

Mendel's law has been explained so often and illustrated by such a large number of devices that only a brief summary of the elementary theory is necessary at this place. The explanation assumes the factorial hypothesis, probably the best and simplest yet proposed.

Certain morphological and physiological features of organic individuals have been observed to be transmitted from parent to offspring in certain definite ways that correspond to the occurrence of certain events in some simple games of chance. These individual morphological and physiological features are commonly called characters. Accordingly, it has come to be accepted that if there are such things as hereditary bases or units of characters controlling the development of parts or organs, they probably perform in certain definite ways in the hereditary process. To satisfactorily account for the facts of inheritance, it is customary to consider that the factorial basis for each character is double in nature, one-half or one part of the basis being contributed by the male parent or element and the other half or part by the female parent or element. The unit or part contributed by each parent is called a factor. The two members of each factor pair are associated thruout the development of the organism. But apparently they do not combine in any such way as to lose their identity. The dual factorial basis of characters is illustrated in Fig. 1, it being supposed for purposes of illustration that R stands for the factor that produces the character red chaff in wheat.

The cells of each parent plant carry the double factor RR. Somewhere during the formation of the pollen grains and ovules the two factors divide or separate in such a way as to leave only one factor in each germ cell. Then, by the union of the gametes in the fertilizing process, the double condition of the factors is restored. Long before Mendel's law was rediscovered, Weismann reasoned that somewhere in the hereditary process, there must be a halving of the hereditary material in order to prevent an undue accumulation of it. The somewhat unusual way in which the factorial hypothesis satisfied the Weismann speculation has served to attract an extraordinary amount of attention to the circumstance.

When parents with dissimilar corresponding characters mate, the case is not so simple, and various interesting phenomena occur.

[1] The Small Grains, p. 175.

It was by restricting his attention to differing homologous characters that Mendel discovered the law that bears his name. If a red chaff wheat is crossed with one having white chaff, the scheme of representation will appear as in Fig. 2. The hybrid wheat in such a cross will have red chaff, but according to the factorial hypothesis the double factorial basis of the character red chaff will not consist of two R factors but of a red factor, R, and a white factor, W. In such a case the R factor is said to be the dominant factor or character. The influence of the factors of any pair is not equal. The factor for red causes the production of red chaff in spite of or regardless of the factor for white. As a result, the hybrid resembles only one of the parents; the characters of the other parent are covered over or suppressed. However, they are not obliterated. Neither are they changed in any way as we shall see later. Again in other factor pairs the influence or power of the two factors is more nearly equal and as a result there appears in the hybrid a character that is unlike that of either parent. Very often this hybrid character is intermediate in nature between the two differing characters of the parents.

The pairs of factors are called allelomorphs. For example, the factors for red chaff and white chaff are allelomorphs and constitute an allelomorphic pair in a cross between red and white chaff wheats. A single character, when spoken of in some connection with the other character of a pair, is often called an allelomorph, as, red chaff is the allelomorph of white chaff. The two characters produced by an allelomorphic pair of factors are sometimes called the allelomorphs.

It is supposed that when the gametes develop in the hybrid R W wheats, the splitting apart of the factors of a pair takes place as usual and two sorts of pollen grains and two sorts of ovules are the result. The process is represented diagrammatically in Fig. 2. One-half of the pollen grains carry an R factor and the other half a W factor. Similarly one-half of the ovules carry an R factor and the other half a W factor. Then if hybrid individuals are mated, or if self fertilization occurs, as it does in wheat, there are four equally possible combinations of factors that may take place: An R factor carried by a pollen grain may combine with an R factor carried by an ovule; an R factor carried by a pollen grain may combine with a W factor carried by an ovule; a W factor of a pollen grain may combine with an R factor of an ovule; and finally, a W factor of a pollen grain may unite with a W factor of an ovule. As any one of the four possible combinations is equally likely to occur, the probability of each occurrence is expressed as ¼ or 0.25, therefore the probability of either an RR or WW combination is 0.25. But the probability of an RW combination is 0.50 because it occurs in two of the four equally possible combinations. The zygotes with the RR combination will give rise to plants that are pure homozygous with respect to red chaff. Such plants, if mated with their kind or self fertilized, will produce nothing but red chaff progeny. Plants developing from WW zygotes likewise produce nothing but white chaff progeny when mated with their kind or self fertilized. Under like conditions of mating or fertilization, the R W plants do not produce similar progeny but give rise to three sorts of plants in exactly the same way as did the F_1 hybrid plants. Such plants as the RW sort are called heterozygous. They result from the union of gametes that brings together in the zygote the two factors of an allelomorphic pair.

As explained above the RW plants are red chaffed and cannot be clearly distinguished from the RR plants. The total probability of occurrence, therefore, of a red plant is 0.75. Since the probability of occurrence of a WW plant is 0.25, the ratios of the probabilities of occurrence of the red to the white plants is as 0.75 is to 0.25 or as 3 is to 1. The ratio is usually expressed in the latter way. Where only one allelomorphic pair of factors is under consideration in a cross, it is customary to designate the cross as monohybrid. If two pairs of factors are involved, the cross is a dihybrid, and when three pairs of factors are concerned, the cross is a trihybrid. In the above hypothetical cross where the probability of occurrence of the two sorts of plants in the F_2 generation is as 3 is to 1, the F_2 ratio can be spoken of as the monohybrid 3:1 ratio. If it were possible to distinguish the RW plants from the RR plants, there would be three sorts of plants in the F_2 generation, RR, RW, and WW, with probabilities of occurrence of 0.25, 0.50, and 0.25, respectively. This gives rise to the monohybrid 1:2:1 ratio.

If two pairs of factors are observed and they segregate and recombine independently of each other, the recombinations with their various manifestations in the F_2 generation can be easily calculated by working out all the equally possible combinations as was done for one pair of factors. If a beardless red wheat were crossed with a bearded white, the factors being Bl for beardless, Bd for bearded, R for red and W for white, then the gametic composition of the hybrid would be Bl Bd RW. The hybrid plants would produce four sorts of pollen grains and four sorts of ovules, i. e., BlR, BlW, BdR, and BdW, and the probability of occurrence of each would be the same. Then in self fertilization or in the mating of hybrids, there would be sixteen different but equally possible combinations of gametes. If beardless is considered as dominant over beards and red over white, there will be four visibly different classes of plants in the F_2 generation. Nine of the sixteen equally possible combinations will produce beardless red plants, three of the combinations will produce beardless white plants, three will produce bearded red, and only one will produce bearded white. Thus there is obtained the dihybrid F_2 9:3:3:1 ratio. If three character pairs are considered, the F_1 or hybrid plants will give rise to eight sorts of pollen grains and eight sorts of ovules, the probability of occurrence of each sort being equal. Then, with the mating of hybrids or with self fertilization, there will occur 64 equally possible but different combinations of gametes according to the factors they contain. There will be eight visibly different classes and the probabilities of occurrences in each class give rise to the trihybrid F_2 ratio, 27:9:9:9:3:3:3:1.

Many other different sorts of ratios are possible and do occur in breeding practice. But as no other ratios than the above are considered in this study, the reader is left to other sources of information regarding them. Also, if the reader is unable to follow the derivation of the ratios by the method of probabilities that is used, there are numerous simpler diagrammatic methods easily accessible. But if one is somewhat familiar with the theory of probabilities, he will appreciate much more the studies on the frequency distributions attempted in the following pages.

ON THE PROBABLE ERROR OF MENDELIAN CLASS FREQUENCIES

It is very apparent that complete agreement of the observed class frequencies with the theoretical class frequencies occurs rather infrequently. Small deviations from the theoretical frequencies occur often. Large deviations occur rarely. With the large amount of data in this experiment, the relative frequency of occurrence of small and large deviations stands out rather clearly. Everyone recognizes, of course, that where pure chance is supposed to control the recombinations of factors by the union of the gametes in fertilization, it is to be expected that the actual observed frequencies will often be different from the theoretical. However, if the segregated factors in the gametes do recombine strictly according to chance, the observed frequencies in any one class will deviate from the theoretical frequencies by a well known law and will, if a large number of samples are taken, form a frequency distribution known as the binomial distribution. This distribution is the one found by the expansion of the binomial $N(p + q)^n$ where p is the relative probability of the class under consideration and q is 1 — p, the sum of $p + q = 1$. The letter n stands for the number of individuals in the sample or the size of the population and N is the number of samples. If we took 1000 F_2 populations of crosses between bearded and beardless wheats and each population had just twelve individuals, the formula for the frequency distribution of the dominant or 3 class would be $1000(0.75 + 0.25)^{12}$. If each population were divided into beardless and bearded plants according to the probabilities of occurrence in each class, there would be nine beardless and three bearded plants in each sample of twelve. But frequently there will be samples with eight or ten beardless plants. Less frequently there will be samples with seven or six beardless plants or even eleven or twelve. By expanding the formula $1000(0.75 + 0.25)^{12}$, we can calculate the probable frequency of occurrence of samples with six, seven, eight, nine, ten, or eleven beardless plants in a thousand populations of twelve plants each. In an actual case of a thousand such samples the agreement of the actual distribution with the probable distribution will not be complete, but it will be very close if the segregation and recombination of the Mendelian factors takes place according to the laws of chance as it is supposed to do. To make this clearer the expansion of the above formula is given in Table 18. This shows the probability of occurrence of the different frequencies in a thousand samples of twelve each. Also, there are given the results of a game so constructed as to correspond exactly with the supposed composition and combinations of the gametes produced by the F_1 plants from a cross of a bearded with a beardless wheat.

By referring to the table it is seen that the probability of occurrence of nine beardless plants out of the twelve is 258 times in a thousand, or only about one in four. That is, it would be unreasonable in such a cross and with the small F_2 samples of twelve plants to expect a complete agreement of the observed with the theoretical occurrence more frequently than in one-fourth of the samples. F_2 populations of as small a number as twelve occur rarely in wheat crosses. The common size is much larger. It is interesting in this connection to note the decrease in probability of agreement between the observed and theoretical when the size of the sample is increased. With samples of 24 instead of twelve the 3:1 distribution of 18 beardless to 6 bearded will occur only about 185 times in a thousand or in less than one-fifth of the samples. For populations of 100 the probable occurrence of samples with 75 beardless and 25 bearded is only 92 out of a thousand samples or in less than one-tenth of the cases. Therefore, it is unreasonable to attempt any argument against the Mendelian theory on the grounds of the infrequent occurrence of samples divided exactly according to the probability ratios. A little acquaintance with the binomial distribution, the probability of occurrence of the theoretical ratios and the distribution of the frequencies differing from the theoretical will often clear up matters of doubt on statistical grounds regarding the validity of the Mendelian theory.

TABLE 18

Frequency Distribution of Occurrences in the F_2 3 and 1 Mendelian Classes for Populations or Samples of 12 Individuals. Total Number of Samples is 1,000. Probabilities are Given to the Nearest Unit.

Beardless (3 Class)	Bearded (1 Class)	Probability of Occurrence in 1,000 Samples	Observed Distribution in the Corn Problem
12	0	32	27
11	1	127	108
10	2	232	225
9	3	258	273
8	4	194	213
7	5	103	91
6	6	41	47
5	7	11	13
4	8	2	2
3	9	..	1
2	10	..	..
1	11	..	..
0	12	..	..
		1,000	1,000

The results of the game given in Table 18 were obtained in the following way: 500 yellow kernels of corn were mixed with 500 white kernels. If the yellow kernels represented the factor for beardless wheat and the white kernels the factor for beards, the combinations of two drawn from the mixture would parallel the supposed combination of the factors in self fertilization of F_1 wheat plants from a cross between beardless and bearded wheats. When drawing two at a time from the mixture, it is easily seen that a yellow kernel may be drawn with a yellow kernel. This would correspond to the union of factors producing a homozygous beardless F_2 plant. Also, a yellow kernel may be drawn with a white or a white may be drawn with a yellow, corresponding to the production of heterozygous beardless plants. Finally, a white kernel may be drawn with a white and thus correspond to the production of a homozygous bearded F_2 plant. The probability of a yellow pair is 0.25, the probability of a yellow white pair is 0.50, and the probability of a white pair is 0.25. Thus, there occurs a complete agreement with the probability of combinations of factors in the F_2 population of a monohybrid cross. The total probability of a yellow pair or a yellow white pair is 0.75 and the probability of a white pair is 0.25. The ratio of the probabilities is as 3 is to 1. By drawing a thousand sets of twelve pairs each from such a mixture and recording the yellow and yellow white pairs together to represent the beardless plants in the 3:1 ratio, we should get a distribution of the frequencies of occurrence in samples of twelve that corresponds very closely to that obtained by expanding the binomial $1000(0.75 + 0.25)^{12}$. The results of the game and expanded binomial recorded in the table are easily seen to agree very closely. Each set of twelve pairs drawn was returned to the mixture before drawing another set.

However, it is not intended to encourage the use of loose or elastic methods to test the agreement of Mendelian theories with the ratios obtained in practice. There has been a tendency to alter theories or to propose new schemes of inheritance without employing samples sufficient either in number or size. The limitations of numbers in animal breeding in general is a serious difficulty and may often lead to erroneous conclusions unless the pitfalls of few numbers are well guarded against. In the above samples where is given the chances of obtaining the various deviations from the 9:3 frequency in samples of twelve, there is a 0.34 probability of occurrence of the reverse ratio or 3 beardless to 9 bearded plants. This means that such a distribution will occur three or four times in ten thousand samples, a possibility not entirely remote. In fact, it was obtained once in the above corn game. A theory built upon such a rare occurrence as this would be entirely wrong and yet such an event is entirely within the bounds of possibility. Acquaintance with the binomial law should make one more cautious in testing the agreement of fact with theory.

As it is difficult to work out binomial distributions because of the large amount of mathematical calculation involved, it is next to impossible to employ this method in a study of a large number of F_2 and F_3 populations. But fortunately it is easy to compute the mean and the standard deviation of the binomial series or distribution. The mean of the binomial $(p + q)^n$ is np and the standard deviation is $\sqrt{npq}$, therefore, 0.6745 times the standard deviation, gives the probable error of the binomial distribution. The probable error, of course, gives the limits or values within which or without which one-half of the frequencies will occur. To be reasonably applicable n should be of fair size. The agreement in the case of the corn problem above shows that its application to as few a number as twelve is not altogether unreasonable. Furthermore p must not be very close to one or to zero in value. The test which it has been chosen to apply to the preceding Mendelian frequencies is the probable error of the binomial distribution. There are enough F_2 and F_3 populations to make a fair test of the Mendelian theory by the occurrence of the class frequencies within or without the probable error limits. If the segregation and recombinations of the factors actually take place according to pure chance, then in a large number of F_2 distributions one-half of the actual frequencies obtained should occur within the limits set by the probable error values and one-half should occur without the limits. Accordingly the probable error has been calculated for the various classes of the F_2 3:1, the F_2 9:3:3:1, and the F_2 27:9:9:9;3:3:3:1 ratios (excepting for the 1 class in the last two) for populations varying in size from the sum of the theoretical ratios up to 500. In the case of the 1 class of the last two ratios the value of p is so small as to make the applicability of the binomial distribution doubtful, and therefore this class has been omitted.

The formula for the probable error of the binomial curve is $0.6745 \sqrt{npq}$. For the F_2 ratio of 3:1, $p = 0.75$ and $q = 0.25$. For a population of four, say, the probable error (P. E.) $= 0.6745 \sqrt{4 \times 0.75 \times 0.25}$. For a population of 50, P. E. $= 0.6745 \sqrt{50 \times 0.75 \times 0.25}$, and for a population of 500, P. E. $= 0.6745 \sqrt{500 \times 0.75 \times 0.25}$. Where there are only two classes in a ratio, the P. E. of both is alike, for an excess in one class is accompanied by an equal deficiency in the other. Hence the P. E. formula for either class of the 3:1 ratio is identical. These values of the probable errors for the 3 and the 1 classes of the 3:1 ratio have been calculated for populations from 4 to 500 and are tabulated in Table 90. The form of the table follows that of an ordinary logarithmic table. The table is entered from the lefthand column and the top row. The last digit of any number is in the top row. For example, if it is desired to find the P. E. of the frequency distribution for the 3 class of the 3:1 ratio in populations of 127 individuals, find 12 in the lefthand column and 7 at the top. The value of the P. E. desired will then be found at the intersection of the 12 row and the 7 column and is 3.29.

Having before us the following 3:1 F_2 frequencies, we will suppose that we wish to find out how many of the 3 classes are within the P. E. limits and how many are without.

	Observed F_2 3:1 Frequencies (1)	Theoretical Frequencies For Same Sized Sample (2)	Total Population (3)	Difference Between Theoretical and Observed (4)	Probable Error (5)	In or Out (6)
(1)	21-5	19.5- 6.5	26	1.5	1.49	out
(2)	27-10	27.8- 9.3	37	0.8	1.78	in
(3)	22-6	21.0- 7.0	28	1.0	1.55	in
(4)	44-16	45.0-15.0	60	1.0	2.26	in
(5)	77-23	75.0-25.0	100	2.0	2.92	in
(6)	170-41	158.3-52.8	211	11.7	4.24	out

The observed frequencies are given in column 1. The theoretical frequencies corresponding are given in column 2, and the sum of the classes or size of the sample or population in column 3. The difference between the theoretical and observed frequencies for the 3 class is given in column 4. This difference is the same in absolute value for the 1 class but opposite in sign. The P. E. of the frequency distribution of the 3 class for the corresponding sized sample or population is given in column 5. Again the value of the P. E. is the same for the 1 class. In column 6 is indicated by "in" or "out" whether the observed class frequency lies within or without the probable error limits calculated from the binomial distribution. In this case if the 3 class is "in", the 1 class is also within. If the 3 class is "out", the 1 class is "out". This does not apply to ratios where there are more than two classes as in the 9:3:3:1 ratio.

The first observed distribution is 21 beardless to 5 bearded plants, the 3 class being 21. The sum of the two classes or total population is 26. Turning to Table 87 where the theoretical 3:1 frequencies for F_2 populations from 4 to 500 are tabulated, we find after 26 on the left of the table the theoretical frequency of 19.5 to 6.5. The difference between the theoretical and observed frequencies is 1.5. The questions that now arise are: How does this deviation of the observed frequencies from the theoretical frequencies compare with the probable error of the class frequency distribution curve? Is the deviation less or greater than the probable error?

By turning to Table 90 where the probable errors of the frequency distributions for the F_2 3 and 1 classes are tabulated and looking up the probable error corresponding to 26 under 2 at the left of the table and 6 at the top, we find the value to be 1.49. For simplicity the probable errors are listed under the values of the entire F_2 population under observation and not under the theoretical frequency of any one class. The actual observed deviation of 1.5 is only slightly greater than the P. E. 1.49. But as it is somewhat larger, the observed class is listed as just without the P. E. limit and the "out" in column 6 indicates this. Since, as explained before, the 3 and 1 classes are always both within or without the P. E. limits, the 1 class, with an observed value of 5 and a theoretical value of 6.5 has also a difference of 1.5, which is larger than its P. E. value of 1.49. For this reason Table 90 is described as the probable errors of the class frequency distributions for both the 3 and 1 classes of the monohybrid F_2 3:1 ratio.

The theoretical class frequencies for the F_2 9:3:3:1 ratio for populations from 16 to 500 is given in Table 88. As the two 3 classes are alike, the class is listed only once. The P. E.s of the frequency distribution curves of occurrences in the 9 and 3 classes are given in Tables 91 and 92. For reasons already given it was thought unwise to include the 1 class at this time. By following exactly the same method as described for the 3 class of the 3:1 ratio it is easy to compare any difference between an observed and theoretical frequency for the 9 or either of the 3 classes with the P. E. of the frequency distribution curve of occurrences in any of those classes. The tables give the P. E.s of the classes for F_2 populations varying in size from 16 to 500. It must be remembered that the performance in any one class gives no indication of what can be expected in the other classes. An occurrence of a 9 class frequency within the values set by the P. E. limits does not indicate the position of either of the 3 classes as it did in the 3:1 ratio. It is only when the ratio consists of two classes that the behaviour of one class is accompanied by a like behaviour in the other class differing only in sign but not in degree.

The theoretical F_2 27:9:9:9:3:3:3:1 ratios for populations from 64 to 500 are given in Table 89. The classes of like size are not repeated but are given only once. The P. E.'s of the frequency distribution curves of occurrence for the 27, the 9, and the 3 classes are given in Tables, 93, 94, and 95 respectively. The use of the tables is exactly similar to that already described for the simpler ratios. The 1 class is omitted because of its small probability.

DESCRIPTION OF TABLES

On the following pages there is presented in tabular form the results of probable error studies carried out according to the methods under the section, On the Probable Error of Mendelian Class Frequencies. The material for the studies came from two sources. First, there are the F_2 populations from the original crosses already described and tabulated. Second, a large number of the F_3 populations were secured in the progeny of numerous plant selections made from the F_2 generation of certain crosses. A considerable number of selections were made from each of the visibly different Mendelian classes that occurred in each cross. In the dihybrid and trihybrid crosses, these selections gave rise to different sorts of F_3 progenies depending upon the gametic composition of the selections. A discussion of the different sorts of progenies has already been given under the section, Behavior in the F_3 Generation. At the head of each table, a complete description has been given telling for just what characters any selection was homozygous. The studies on the F_2 populations occupy the tables from No. 19 to No. 35 inclusive.

Summaries have been introduced frequently to make the results more clear. The F_3 generation studies occupy all the tables from No. 36 to No. 77 inclusive. By introducing rather long general and table headings, it is believed that those interested can easily follow the detailed data. For those who do not care to observe the results in all the numerous progenies, a summary of the results has been made and occupies the tables from No. 78 to No. 86 inclusive.

Largely for our own convenience, the cross history number of each progeny has been given. The system followed is a simple one often used. Each cross when made is given a number. The F_1 plants from a cross are numbered from 1 consecutively, as, 15-1, 15-2, etc., in cross No. 15. If selections are made from any of the F_2 progenies they are also numbered from 1 consecutively, and these numbers are then combined with the F_1 parent plant number. For example, F_2 selections from the progeny of the F_1 plant 15-2 are numbered 15-2-1, 15-2-2, etc. The F_1 barley plants were not kept separate in these crosses hence the 0 in the cross history numbers.

A probable error study on any one progeny occupies a single block in the tables. At the head of the block is given the cross history number and the number of plants in the progeny. The results in any class are placed in columns and the class is indicated by the ratio number placed in parentheses at the head of the column. In the row entitled, Observed, and printed in bold face type are given the frequencies actually observed in any progeny. The expected or theoretical frequencies are given in the next row and are printed in light face type. The arithmetic difference between the theoretical and observed results then follows in bold face type. The probable error of similarly sized binomial frequency distributions is given in light face type in the last row of figures. And, finally, is indicated by in or out, whether the difference in the third row is arithmetically less or greater than the probable error given in the fourth row.

The theoretical ratios and probable errors were all found from the tables given in the latter part of the bulletin excepting for summarized populations of over 500, which the tables do not cover. These tables have been carefully checked and it is believed that no errors occur in them. It is thought that they will be found very useful to students of genetics desiring to undertake similar studies.

DISCUSSION OF RESULTS AND SUMMARY

This bulletin has been prepared mainly for the purpose of presenting the results of certain studies, carried on at this station, that have a bearing on certain live problems of Mendelian inheritance of characters. Altho a considerable number of data have been presented, yet they are not considered enough to justify us in forming any definite conclusions regarding the problem of the differences that occur between the observed and theoretical frequencies in Mendelian classes.

The first part of the bulletin is devoted to a description of the various crosses made and the several parent varieties used. The F_1 appearance and the F_2 behavior is given in detail for the purpose of contributing to the rather large, yet none too large, body of literature on wheat and barley crosses. The main problem about which the studies center is then presented and the method of attack described. The differences that occur between observed and expected frequencies in Mendelian classes have been a source of considerable controversy and have often been cited as sufficient cause to invalidate the whole theory, altho the attacks have been directed more especially towards the factorial hypothesis and certain other hypotheses. Believing that Mendelists should welcome and use all valid tests of their theories, this bulletin is the outcome of an attempt to apply such a test to a part of the Mendelian work that has been done at this station. In brief the test has been this: If the characters of organisms are the developmental results of certain factors that are inherited according to the Mendelian Law, then the occurrences of these characters in numerous samples should be such as to conform to the binomial frequency distribution. Because of the difficulty of applying this test to a large number of variously sized populations, a simpler application has been employed, that of the probable error of the binomial distribution. This is easily calculated and tables of its value for certain classes for populations up to as large as 500 have been prepared. It is recognized that if pure chance controls the recombinations of factors in the combining gametes, then, in a large number of cases, the differences between observed and theoretical results should be divided about equally between values less than and greater than the probable error of the binomial frequency distribution of those differences.

Altogether such a test has been applied to the occurrences in 1,865 different cases. Of these 896 were within the probable error limits and 969 were without. The results in the different crops and the different Mendelian ratios are given in table No. 86. They do not differ materially from the grand total of all the results. In many cases the test has been applied to populations that were possibly too small in number. Yet the results were quite satisfactory and altho they are not conclusive regarding the main problem, they do show that for practical purposes, the Mendelian Law of Inheritance is an exceedingly useful tool in practical plant breeding. It is hoped that this effort will lead to better and more conclusive tests by other workers. It is recognized that the final settlement of the main problem awaits the discovery by bio-chemists of the real mechanism of inheritance and development.

TABLE 19

Probable Error Studies on the F_2 Population of Cross 15
Harvest King♀ × Fultz Mediterranean♂
F_2 Monohybrid Ratio. Allelomorphic Pair, Red Chaff and White Chaff

	Red Chaff	White Chaff	Red Chaff	White Chaff	Red Chaff	White Chaff
	15-1—26 plants		15-2—37 plants		15-3—28 plants	
	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**21**	**5**	**27**	**10**	**22**	**6**
Theoretical	19.5	6.5	27.8	9.3	21.0	7.0
Difference	**1.5**	**1.5**	**0.8**	**0.7**	**1.0**	**1.0**
Prob. Error	1.49	1.49	1.78	1.78	1.55	1.55
	out	out	in	in	in	in
	15-4— 4 plants		15-5 5 plants		Total population 100 plants	
	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**2**	**2**	**5**	**0**	**77**	**23**
Theoretical	3.0	1.0	3.8	1.3	75.0	25.0
Difference	**1.0**	**1.0**	**1.2**	**1.3**	**2.0**	**2.0**
Prob. Error	0.58	0.58	0.65	0.65	2.92	2.92
	out	out	out	out	in	in

TABLE 20

Probable Error Studies on the F_2 Population of Cross 16
Harvest King♀ × Fultz Mediterranean♂ (Velvet)
F_2 Dihybrid Ratio. Allelomorphic Pairs, Red and White Chaff, Velvet and Smooth Chaff

	Red and Velvet	Red and Smooth	White and Velvet	White and Smooth	Red and Velvet	Red and Smooth	White and Velvet	White and Smooth
	16-1—24 plants				16-2— 44 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**16**	**3**	**4**	**1**	**28**	**8**	**7**	**1**
Theoretical	13.5	4.5	4.5	1.5	24.8	8.3	8.3	2.8
Difference	**2.5**	**1.5**	**0.5**	**0.5**	**3.2**	**0.3**	**1.3**	**1.8**
Probable Error	1.64	1.29	1.29		2.22	1.75	1.75	
	out	out	in		out	in	in	
	16-3—43 plants				Total population—111 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**29**	**8**	**4**	**2**	**73**	**19**	**15**	**4**
Theoretical	24.2	8.1	8.1	2.7	62.4	20.8	20.8	6.9
Difference	**4.8**	**0.1**	**4.1**	**0.7**	**10.6**	**1.8**	**5.8**	**2.9**
Probable Error	2.19	1.73	1.73		3.53	2.77	2.77	
	out	in	out		out	in	out	

TABLE 21

Probable Error Studies on the F_2 Population of Cross 22

Turkey Red♀ × Fultz Mediterranean♂

F_2 Monohybrid Ratio. Allelomorphic Pair, Beardless and Bearded Heads

	Beardless	Bearded	Beardless	Bearded	Beardless	Bearded	Beardless	Bearded	Beardless	Bearded
	22-1—115 plants		22-2—33 plants		22-3—67 plants		22-4—30 plants		22-5—36 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**82**	**33**	**24**	**9**	**49**	**18**	**19**	**11**	**30**	**6**
Theoretical	86.3	28.8	24.8	8.3	50.3	16.8	22.5	7.5	27.0	9.0
Difference	**4.3**	**4.2**	**0.8**	**0.7**	**1.3**	**1.2**	**3.5**	**3.5**	**3.0**	**3.0**
Prob. Error	3.13	3.13	1.68	1.68	2.39	2.39	1.60	1.60	1.75	1.75
	out	out	in	in	in	in	out	out	out	out
	22-6—62 plants		22-7—25 plants		22-8—19 plants		22-9—19 plants		22-11—12 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**44**	**18**	**23**	**2**	**16**	**3**	**13**	**6**	**9**	**3**
Theoretical	46.5	15.5	18.8	6.3	14.3	4.8	14.3	4.8	9.0	3.0
Difference	**2.5**	**2.5**	**4.2**	**4.3**	**1.7**	**1.8**	**1.3**	**1.2**	**0.0**	**0.0**
Prob. Error	2.30	2.30	1.46	1.46	1.27	1.27	1.27	1.27	1.01	1.01
	out	out	out	out	out	out	out	in	in	in
	22-12—57 plants		22-13—60 plants		22-14—9 plants		Total population 544 plants			
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)		
Observed	**45**	**12**	**44**	**16**	**7**	**2**	**405**	**139**		
Theoretical	42.8	14.3	45.0	15.0	6.8	2.3	408.0	136.0		
Difference	**2.2**	**2.3**	**1.0**	**1.0**	**0.2**	**0.3**	**3.0**	**3.0**		
Prob. Error	2.21	2.21	2.26	2.26	0.88	0.88	6.81	6.81		
	in	out	in	in	in	in	in	in		

TABLE 22

Probable Error Studies on the F_2 Population of Cross 23

Turkey Red♀ × Fultz Mediterranean♂

F_2 Monohybrid Ratio. Allelomorphic Pair, Beardless and Bearded Heads

	Beardless	Bearded	Beardless	Bearded	Beardless	Bearded	Beardless	Bearded
	23-1—40 plants		23-2—23 plants		23-3—11 plants		23-4—38 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**29**	**11**	**19**	**4**	**8**	**3**	**29**	**9**
Theoretical	30.0	10.0	17.3	5.8	8.3	2.8	28.5	9.5
Difference	**1.0**	**1.0**	**1.7**	**1.8**	**0.3**	**0.2**	**0.5**	**0.5**
Prob. Error	1.85	1.85	1.40	1.40	0.97	0.97	1.80	1.80
	in	in	out	out	in	in	in	in
	23-5—57 plants		23-6—62 plants		23-7—74 plants		23-8—47 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**42**	**15**	**40**	**22**	**50**	**24**	**38**	**9**
Theoretical	42.8	14.3	46.5	15.5	55.5	18.5	35.3	11.8
Difference	**0.8**	**0.7**	**6.5**	**6.5**	**5.5**	**5.5**	**2.7**	**2.8**
Prob. Error	2.21	2.21	2.30	2.30	2.51	2.51	2.00	2.00
	in	in	out	out	out	out	out	out
	23-9—73 plants		23-10—90 plants		23-11—87 plants		Total population 602 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**53**	**20**	**61**	**29**	**62**	**25**	**431**	**171**
Theoretical	54.8	18.3	67.5	22.5	65.3	21.8	451.5	150.5
Difference	**1.8**	**1.7**	**6.5**	**6.5**	**3.3**	**3.2**	**20.5**	**20.5**
Prob. Error	2.50	2.50	2.77	2.77	2.72	2.72	7.17	7.17
	in	in	out	out	out	out	out	out

TABLE 23

Probable Error Studies on the F_2 Population of Cross 24

Turkey Red♀ × Fultz Mediterranean♂

F_2 Monohybrid Ratio. Allelomorphic Pair, Beardless and Bearded Heads

	Beardless	Bearded	Beardless	Bearded	Beardless	Bearded	Beardless	Bearded	Beardless	Bearded
	24-1—211 plants		24-2—68 plants		24-3—69 plants		24-4—156 plants		24-5—86 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**170**	**41**	**49**	**19**	**48**	**21**	**110**	**46**	**62**	**24**
Theoretical	158.3	52.8	51.0	17.0	51.8	17.3	117.0	39.0	64.5	21.5
Difference	**11.7**	**11.8**	**2.0**	**2.0**	**3.8**	**3.7**	**7.0**	**7.0**	**2.5**	**2.5**
Prob. Error	4.24	4.24	2.41	2.41	2.43	2.43	3.65	3.65	2.71	2.71
	out	out	in	in	out	out	out	out	in	in
	24-6—78 plants		24-7—108 plants		24-8—137 plants		24-9—54 plants		24-10—37 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**55**	**23**	**85**	**23**	**103**	**34**	**40**	**14**	**27**	**10**
Theoretical	58.5	19.5	81.0	27.0	102.8	34.3	40.5	13.5	27.8	9.3
Difference	**3.5**	**3.5**	**4.0**	**4.0**	**0.2**	**0.3**	**0.5**	**0.5**	**0.8**	**0.7**
Prob. Error	2.58	2.58	3.04	3.04	3.42	3.42	2.15	2.15	1.78	1.78
	out	out	out	out	in	in	in	in	in	in
	24-11—30 plants		24-12—83 plants		24-13—47 plants		Total population 1164 plants			
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)		
Observed	**23**	**7**	**60**	**23**	**31**	**16**	**863**	**301**		
Theoretical	22.5	7.5	62.3	20.8	35.3	11.8	873.0	291.0		
Difference	**0.5**	**0.5**	**2.3**	**2.2**	**4.3**	**4.2**	**10.0**	**10.0**		
Prob. Error	1.60	1.60	2.66	2.66	2.00	2.00	9.96	9.96		
	in	in	in	in	out	out	out	out		

TABLE 24

Summary of Probable Error Studies on Crosses 22, 23, and 24

Turkey Red♀ × Fultz Mediterranean♂

F_2 Monohybrid Ratio. Allelomorphic Pair. Beardless and Bearded Heads

	Beardless	Bearded	Beardless	Bearded	Beardless	Bearded	Beardless	Bearded
	Cross 22—544 plants		Cross 23—602 plants		Cross 24—1164 plants		Total population 2310 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**405**	**139**	**431**	**171**	**863**	**301**	**1699**	**611**
Theoretical	408.0	136.0	451.5	150.5	873.0	291.0	1732.5	577.5
Difference	**3.0**	**3.0**	**20.5**	**20.5**	**10.0**	**10.0**	**33.5**	**33.5**
Prob. Error	6.81	6.81	7.17	7.17	9.96	9.96	14.04	14.04
	in	in	out	out	out	out	out	out

TABLE 25

Probable Error Studies on the F_2 Population of Cross 11

Harvest King♀ × Turkey Red♂

F_2 Dihybrid Ratio. Allelomorphic Pairs, Beardless and Bearded Heads, Red and White Chaff

	Beardless Red	Beardless White	Bearded Red	Bearded White	Beardless Red	Beardless White	Bearded Red	Bearded White
	11-1—49 plants				11-2—106 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**27**	**7**	**12**	**3**	**52**	**25**	**21**	**8**
Theoretical	27.6	9.2	9.2	3.1	59.6	19.9	19.9	6.6
Difference	**0.6**	**2.2**	**2.8**	**0.1**	**7.6**	**5.1**	**1.1**	**1.4**
Prob. Error	2.34	1.84	1.84		3.45	2.71	2.71	
	in	out	out		out	out	in	
	Total population—155 plants							
	(9)	(3)	(3)	(1)				
Observed	**79**	**32**	**33**	**11**				
Theoretical	87.2	29.1	29.1	9.7				
Difference	**8.2**	**2.9**	**3.9**	**1.3**				
Prob. Error	4.17	3.28	3.28					
	out	in	out					

TABLE 26

Probable Error Studies on the F_2 Population of Cross 13

Harvest King♀ × Turkey Red♂

F_2 Dihybrid Ratio. Allelomorphic Pairs, Beardless and Bearded Heads, Red and White Chaff

	Beardless Red	Beardless White	Bearded Red	Bearded White	Beardless Red	Beardless White	Bearded Red	Bearded White
	13-1—49 plants				13-2—114 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**24**	**12**	**8**	**5**	**51**	**27**	**30**	**6**
Theoretical	27.6	9.2	9.2	3.1	64.1	21.4	21.4	7.1
Difference	**3.6**	**2.8**	**1.2**	**1.9**	**13.1**	**5.6**	**8.6**	**1.1**
Prob. **Error**	2.34	1.84	1.84		3.57	2.81	2.81	
	out	out	in		out	out	out	
	13-3—100 plants				13-4—30 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**53**	**21**	**20**	**6**	**20**	**4**	**5**	**1**
Theoretical	56.3	18.8	18.8	6.3	16.9	5.6	5.6	1.9
Difference	**3.3**	**2.2**	**1.2**	**0.3**	**3.1**	**1.6**	**0.6**	**0.9**
Prob. **Error**	3.35	2.63	2.63		1.83	1.44	1.44	
	in	in	in		out	out	in	
	13-5—19 plants				Total population—312 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**12**	**1**	**5**	**1**	**160**	**65**	**68**	**19**
Theoretical	10.7	3.6	3.6	1.2	175.5	58.5	58.5	19.5
Difference	**1.3**	**2.6**	**1.4**	**0.2**	**15.5**	**6.5**	**9.5**	**0.5**
Prob. **Error**	1.46	1.15	1.15		5.91	4.65	4.65	
	in	out	out		out	out	out	

TABLE 27

Summary of Probable Error Studies on Crosses 11 and 13
Harvest King♀ × Turkey Red♂
F_2 Dihybrid Ratio. Allelomorphic Pairs, Beardless and Bearded Heads,
Red and White Chaff

	Beardless Red	Beardless White	Bearded Red	Bearded White	Beardless Red	Beardless White	Bearded Red	Bearded White
	Cross 11—155 plants				Cross 13—312 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**79**	**32**	**33**	**11**	**160**	**65**	**68**	**19**
Theoretical	87.2	29.1	29.1	9.7	175.5	58.5	58.5	19.5
Difference	**8.2**	**2.9**	**3.9**	**1.3**	**15.5**	**6.5**	**9.5**	**0.5**
Prob. Error	4.17	3.28	3.28		5.91	4.65	4.65	
	out	in	out		out	out	out	
	Total population—467 plants							
	(9)	(3)	(3)	(1)				
Observed	**239**	**97**	**101**	**30**				
Theoretical	262.7	87.6	87.6	29.2				
Difference	**23.7**	**9.4**	**13.4**	**0.8**				
Prob. Error	7.23	5.69	5.69					
	out	out	out					

TABLE 28

Probable Error Studies on the F_2 Population of Cross 19
Turkey Red♀ × Harvest King♂
F_2 Dihybrid Ratio. Allelomorphic Pairs, Beardless and Bearded Heads,
Red and White Chaff

	Beardless Red	Beardless White	Bearded Red	Bearded White	Beardless Red	Beardless White	Bearded Red	Bearded White
	19-1—63 plants				19-2-135 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**30**	**10**	**17**	**6**	**91**	**15**	**22**	**7**
Theoretical	35.4	11.8	11.8	3.9	75.9	25.3	25.3	8.4
Difference	**5.4**	**1.8**	**5.2**	**2.1**	**15.1**	**10.3**	**3.3**	**1.4**
Prob. Error	2.66	2.09	2.09		3.89	3.06	3.06	
	out	in	out		out	out	out	

TABLE 28 (Continued)

	Beardless Red	Beardless White	Bearded Red	Bearded White	Beardless Red	Beardless White	Bearded Red	Bearded White
	19-3—94 plants				19-4—29 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**56**	**10**	**24**	**4**	**13**	**5**	**9**	**2**
Theoretical	52.9	17.6	17.6	5.9	16.3	5.4	5.4	1.8
Difference	**3.1**	**7.6**	**6.4**	**1.9**	**3.3**	**0.4**	**3.6**	**0.2**
Prob. Error	3.24	2.55	2.55		1.80	1.42	1.42	
	in	out	out		out	in	out	
	19-5—78 plants				19-6—19 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**43**	**15**	**17**	**3**	**6**	**6**	**4**	**3**
Theoretical	43.9	14.6	14.6	4.9	10.7	3.6	3.6	1.2
Difference	**0.9**	**0.4**	**2.4**	**1.9**	**4.7**	**2.4**	**0.4**	**1.8**
Prob. Error	2.96	2.33	2.33		1.46	1.15	1.15	
	in	in	out		out	out	in	
	19-7—72 plants				19-8—59 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**43**	**11**	**16**	**2**	**33**	**8**	**16**	**2**
Theoretical	40.5	13.5	13.5	4.5	33.2	11.1	11.1	3.7
Difference	**3.5**	**2.5**	**2.5**	**2.5**	**0.2**	**3.1**	**4.9**	**1.7**
Prob. Error	2.84	2.23	2.23		2.57	2.02	2.02	
	out	out	out		in	out	out	
	Total population—549 plants							
	(9)	(3)	(3)	(1)				
Observed	**315**	**80**	**125**	**29**				
Theoretical	308.8	102.9	102.9	34.3				
Difference	**6.2**	**22.9**	**22.1**	**5.3**				
Prob. Error	7.84	6.17	6.17					
	in	out	out					

TABLE 29

Probable Error Studies on the F_2 Population of Cross 20

Turkey Red♀ × Harvest King♂

F_2 Dihybrid Ratio. Allelomorphic Pairs, Beardless and Bearded Heads, Red and White Chaff

	Beardless Red	Beardless White	Bearded Red	Bearded White	Beardless Red	Beardless White	Bearded Red	Bearded White
	Total population—32 plants							
	(9)	(3)	(3)	(1)				
Observed	**17**	**3**	**8**	**4**				
Theoretical	18.0	6.0	6.0	2.0				
Difference	**1.0**	**3.0**	**2.0**	**2.0**				
Prob. Error	1.89	1.49	1.49					
	in	out	out					

TABLE 30

Probable Error Studies on the F_2 Population of Cross 21

Turkey Red♀ × Harvest King♂

F_2 Dihybrid Ratio. Allelomorphic Pairs, Beardless and Bearded Heads, Red and White Chaff

	Beardless Red	Beardless White	Bearded Red	Bearded White	Beardless Red	Beardless White	Bearded Red	Bearded White
	21-1—110 plants				21-2—88 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**61**	**20**	**22**	**7**	**45**	**21**	**16**	**6**
Theoretical	61.9	20.6	20.6	6.9	49.5	16.5	16.5	5.5
Difference	**0.9**	**0.6**	**1.4**	**0.1**	**4.5**	**4.5**	**0.5**	**0.5**
Prob. Error	3.51	2.76	2.76		3.14	2.47	2.47	
	in	in	in		out	out	in	
	21-3—111 plants				21-4—49 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**65**	**18**	**22**	**6**	**32**	**8**	**7**	**2**
Theoretical	62.4	20.8	20.8	6.9	27.6	9.2	9.2	3.1
Difference	**2.6**	**2.8**	**1.2**	**0.9**	**4.4**	**1.2**	**2.2**	**1.1**
Prob. Error	3.53	2.77	2.77		2.34	1.84	1.84	
	in	out	in		out	in	out	

TABLE 30 (Continued)

	Beardless Red	Beardless White	Bearded Red	Bearded White	Beardless Red	Beardless White	Bearded Red	Bearded White
	21-5—48 plants				Total population—406 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**22**	**7**	**13**	**6**	**225**	**74**	**80**	**27**
Theoretical	27.0	9.0	9.0	3.0	228.4	76.1	76.1	25.4
Difference	**5.0**	**2.0**	**4.0**	**3.0**	**3.4**	**2.1**	**3.9**	**1.6**
Prob. Error	2.32	1.82	1.82		6.74	5.31	5.31	
	out	out	out		in	in	in	

TABLE 31

Summary of Probable Error Studies on Crosses 19, 20 and 21

Turkey Red♀ × Harvest King♂

F_2 Dihybrid Ratio. Allelomorphic Pairs, Beardless and Bearded Heads, Red and White Chaff

	Beardless Red	Beardless White	Bearded Red	Bearded White	Beardless Red	Beardless White	Bearded Red	Bearded White
	Cross 19—549 plants				Cross 20—32 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**315**	**80**	**125**	**29**	**17**	**3**	**8**	**4**
Theoretical	308.8	102.9	102.9	34.3	18.0	6.0	6.0	2.0
Difference	**6.2**	**22.9**	**22.1**	**5.3**	**1.0**	**3.0**	**2.0**	**2.0**
Prob. Error	7.84	6.17	6.17		1.89	1.49	1.49	
	in	out	out		in	out	out	
	Cross 21—406 plants				Total population—987 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**225**	**74**	**80**	**27**	**557**	**157**	**213**	**60**
Theoretical	228.4	76.1	76.1	25.4	555.2	185.1	185.1	61.7
Difference	**3.4**	**2.1**	**3.9**	**1.6**	**1.8**	**28.1**	**27.9**	**1.7**
Prob. Error	6.74	5.31	5.31		10.51	8.27	8.27	
	in	in	in		in	out	out	

TABLE 32

Summary of Probable Error Studies on Crosses 11 and 13

Harvest King♀ × Turkey Red♂

and Crosses 19, 20 and 21

Turkey Red × Harvest King

F_2 Dihybrid Ratio. Allelomorphic Pairs, Beardless and Bearded Heads, Red and White Chaff

	Beardless Red	Beardless White	Bearded Red	Bearded White	Beardless Red	Beardless White	Bearded Red	Bearded White
	Crosses 11 and 13—467 plants				Crosses 19, 20 and 21—987 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**239**	**97**	**101**	**30**	**557**	**157**	**213**	**60**
Theoretical	262.7	87.6	87.6	29.2	555.2	185.1	185.1	61.7
Difference	**23.7**	**9.4**	**13.4**	**0.8**	**1.8**	**28.1**	**27.9**	**1.7**
Prob. Error	7.23	5.69	5.69		10.51	8.27	8.27	
	out	out	out		in	out	out	
	Total population—1454 plants							
	(9)	(3)	(3)	(1)				
Observed	**796**	**254**	**314**	**90**				
Theoretical	817.9	272.6	272.6	90.9				
Difference	**21.9**	**18.6**	**41.4**	**0.9**				
Prob. Error	12.76	10.04	10.04					
	out	out	out					

TABLE 33

Probable Error Studies on the F_2 Population of Crosses 30 and 31

California ♀ × Beardless♂

F_2 Monohybrid Ratio. Allelomorphic Pair, Hoods and Beards

	Hooded	Bearded	Hooded	Bearded	Hooded	Bearded
	Cross 30—1834 plants		Cross 31—1724 plants		Total population—3558 plants	
	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**1402**	**432**	**1271**	**453**	**2673**	**885**
Theoretical	1375.5	458.5	1293.0	431.0	2668.5	889.5
Difference	**26.5**	**26.5**	**22.0**	**22.0**	**4.5**	**4.5**
Prob. Error	12.51	12.51	12.13	12.13	17.42	17.42
	out	out	out	out	in	in

TABLE 34

Probable Error Studies on the F_2 Population of Cross 32

California♀ × Black Hulled♂

F_2 Dihybrid Ratio. Allelomorphic Pairs, Black and White Hulled Two-rowed and Six-rowed

	Black 2-row	Black 6-row	White 2-row	White 6-row
	Cross 32—2089 plants			
	(9)	(3)	(3)	(1)
Observed	**1167**	**417**	**378**	**127**
Theoretical	1175.1	391.7	391.7	130.6
Difference	**8.1**	**25.3**	**13.7**	**3.6**
Prob. Error	15.29	12.03	12.03	
	in	out	out	

TABLE 35

Probable Error Studies on the F_2 Population of Crosses 36, 37 and 38

Black Hulled♀ × Hooded♂

F_2 Trihybrid Ratio. Allelomorphic Pairs, Hoods and Beards, Black and White Hulled, Two-rowed and six-rowed

	Hooded Black 2-row	Hooded Black 6-row	Hooded White 2-row	Hooded White 6-row	Bearded Black 2-row	Bearded Black 6-row	Bearded White 2-row	Bearded White 6-row
	Cross 36—320 plants							
	(27)	(9)	(9)	(3)	(9)	(3)	(3)	(1)
Observed	**133**	**48**	**42**	**14**	**47**	**19**	**13**	**4**
Theoretical	135.0	45.0	45.0	15.0	45.0	15.0	15.0	5.0
Difference	**2.0**	**3.0**	**3.0**	**1.0**	**2.0**	**4.0**	**2.0**	**1.0**
Prob. Error	5.96	4.20	4.20	2.55	4.20	2.55	2.55	
	in	in	in	in	in	out	in	

TABLE 35 (Continued)

	Hooded Black 2-row	Hooded Black 6-row	Hooded White 2-row	Hooded White 6-row	Bearded Black 2-row	Bearded Black 6-row	Bearded White 2-row	Beardeed White 6-row
				Cross 37—290 plants				
	(27)	(9)	(9)	(3)	(9)	(3)	(3)	(1)
Observed	**133**	**42**	**35**	**15**	**39**	**11**	**9**	**6**
Theoretical	122.3	40.8	40.8	13.6	40.8	13.6	13.6	4.5
Difference	**10.7**	**1.2**	**5.8**	**1.4**	**1.8**	**2.6**	**4.6**	**1.5**
Prob. Error	5.67	3.99	3.99	2.43	3.99	2.43	2.43	
	out	in	out	in	in	out	out	
				Cross 38—753 Plants				
	(27)	(9)	(9)	(3)	(9)	(3)	(3)	(1)
Observed	**327**	**96**	**114**	**28**	**99**	**39**	**36**	**14**
Theoretical	317.7	105.9	105.9	35.3	105.9	35.3	35.3	11.8
Difference	**9.3**	**9.9**	**8.1**	**7.3**	**6.9**	**3.7**	**0.7**	**2.2**
Prob. Error	9.14	6.43	6.43	3.91	6.43	3.91	3.91	
	out	out	out	out	out	in	in	
				Total population—1363 plants				
	(27)	(9)	(9)	(3)	(9)	(3)	(3)	(1)
Observed	**593**	**186**	**191**	**57**	**185**	**69**	**58**	**24**
Theoretical	575.0	191.7	191.7	63.9	191.7	63.9	63.9	21.3
Difference	**18.0**	**5.7**	**0.7**	**6.9**	**6.7**	**5.1**	**5.9**	**2.7**
Prob. Error	12.30	8.66	8.66	5.26	8.66	5.26	5.26	
	out	in	in	out	in	in	out	

PROBABLE ERROR STUDIES ON THE F_3 GENERATION OF CROSS 13

HARVEST KING♀ × TURKEY RED♂

TABLE 36

Dihybrid F_3 Frequency Distributions Obtained in the Progency of F_2 Beardless, Red Chaff Parents That Were Heterzygous With Respect to Both Characters

	Beardless Red	Beardless White	Bearded Red	Bearded White	Beardless Red	Beardless White	Bearded Red	Bearded White
	13-3-3—190 plants				13-3-7—205 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**104**	**37**	**34**	**15**	**112**	**41**	**36**	**16**
Theoretical ...	106.9	35.6	35.6	11.9	115.3	38.4	38.4	12.8
Difference	**2.9**	**1.4**	**1.6**	**3.1**	**3.3**	**2.6**	**2.4**	**3.2**
Prob. Error....	4.61	3.63	3.63		4.79	3.77	3.77	
	out	in	in		in	in	in	
	13-3-20—118 plants				13-3-23—185 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**74**	**22**	**14**	**8**	**99**	**48**	**28**	**10**
Theoretical ...	66.4	22.1	22.1	7.4	104.1	34.7	34.7	11.6
Difference	**7.6**	**0.1**	**8.1**	**0.6**	**5.1**	**13.3**	**6.7**	**1.6**
Prob. Error....	3.64	2.86	2.86		4.55	3.58	3.58	
	out	in	out		out	out	out	
	13-3-26—183 plants				13-3-29—397 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**108**	**31**	**29**	**15**	**257**	**86**	**38**	**16**
Theoretical ...	102.9	34.3	34.3	11.4	223.3	74.4	74.4	24.8
Difference	**5.1**	**3.3**	**5.3**	**3.6**	**33.7**	**11.6**	**36.4**	**8.8**
Prob. Error....	4.53	3.56	3.56		6.67	5.25	5.25	
	out	in	out		out	out	out	
	13-3-30—158 plants				13-3-32—196 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**88**	**36**	**18**	**16**	**99**	**39**	**41**	**17**
Theoretical ...	88.9	29.6	29.6	9.9	110.3	36.8	36.8	12.3
Difference	**0.9**	**6.4**	**11.6**	**6.1**	**11.3**	**2.2**	**4.2**	**4.7**
Prob. Error....	4.21	3.31	3.31		4.68	3.69	3.69	
	in	out	out		out	in	out	
	13-3-34—223 plants				13-3-37—128 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**112**	**43**	**47**	**21**	**74**	**28**	**16**	**10**
Theoretical ...	125.4	41.8	41.8	13.9	72.0	24.0	24.0	8.0
Difference	**13.4**	**1.2**	**5.2**	**7.1**	**2.0**	**4.0**	**8.0**	**2.0**
Prob. Error....	5.00	3.93	3.93		3.79	2.98	2.98	
	out	in	out		in	out	out	
	13-3-38—420 plants				13-3-40—178 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**217**	**79**	**89**	**35**	**97**	**32**	**37**	**12**
Theoretical ...	236.3	78.8	78.8	26.3	100.1	33.4	33.4	11.1
Difference	**19.3**	**0.2**	**10.2**	**8.7**	**3.1**	**1.4**	**3.6**	**0.9**
Prob. Error....	6.86	5.40	5.40		4.46	3.51	3.51	
	out	in	out		in	in	out	

TABLE 36 (Continued)

	Beardless Red	Beardless White	Bearded Red	Bearded White	Beardless Red	Beardless White	Bearded Red	Bearded White
	13-3-45—371 plants				13-3-47—168 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**201**	**75**	**74**	**21**	**95**	**37**	**24**	**12**
Theoretical	208.7	69.6	69.6	23.2	94.5	31.5	31.5	10.5
Difference	**7.7**	**5.4**	**4.4**	**2.2**	**0.5**	**5.5**	**7.5**	**1.5**
Prob. Error	6.45	5.07	5.07		4.34	3.41	3.41	
	out	out	in		in	out	out	
	13-3-50—86 plants				13-3-52—582 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**47**	**18**	**20**	**1**	**323**	**107**	**111**	**41**
Theoretical	48.4	16.1	16.1	5.4	327.4	109.1	109.1	36.4
Difference	**1.4**	**1.9**	**3.9**	**4.4**	**4.4**	**2.1**	**1.9**	**4.6**
Prob. Error	3.10	2.44	2.44		8.07	6.35	6.35	
	in	in	out		in	in	in	
	Total of all progenies 3788 plants							
	(9)	(3)	(3)	(1)				
Observed	**2107**	**759**	**656**	**266**				
Theoretical	2130.8	710.3	710.3	236.8				
Difference	**23.8**	**48.7**	**54.3**	**29.2**				
Prob. Error	20.59	16.20	16.20					
	out	out	out					

TABLE 37

Monohybrid Frequency Distributions Obtained in the F_3 Progenies from F_2 Beardless, Red Chaff Parents That Were Homozygous Beardless and Heterozygous Red Chaff

	Beardless Red	Beardless White	Beardless Red	Beardless White	Beardless Red	Beardless White
	13-3-5—414 plants		13-3-6—269 plants		13-3-14—174 plants	
	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**308**	**106**	**195**	**74**	**142**	**32**
Theoretical	310.5	103.5	201.8	67.3	130.5	43.5
Difference	**2.5**	**2.5**	**6.8**	**6.7**	**11.5.**	**11.5**
Prob. Error	5.94	5.94	4.79	4.79	3.85	3.85
	in	in	out	out	out	out
	13-3-15—45 plants		13-3-22—97 plants		13-3-33—47 plants	
	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**32**	**13**	**74**	**23**	**35**	**12**
Theoretical	33.8	11.3	72.8	24.3	35.3	11.8
Difference	**1.8**	**1.7**	**1.2**	**1.3**	**0.3**	**0.2**
Prob. Error	1.96	1.96	2.88	2.88	2.00	2.00
	in	in	in	in	in	in

TABLE 37 (Continued)

	Beardless Red	Beardless White	Beardless Red	Beardless White	Beardless Red	Beardless White
	13-3-35—353 plants		13-3-46—166 plants		13-3-48—23 plants	
	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**251**	**102**	**123**	**43**	**21**	**2**
Theoretical	264.8	88.3	124.5	41.5	17.3	5.8
Difference	**13.8**	**13.7**	**1.5**	**1.5**	**3.7**	**3.8**
Prob. Error.........	5.49	5.49	3.76	3.76	1.40	1.40
	out	out	in	in	out	out
	13-3-53—317 plants		Total of all progenies—1905 plants			
	(3)	(1)	(3)	(1)		
Observed	**233**	**84**	**1414**	**491**		
Theoretical	237.8	79.3	1428.8	476.3		
Difference	**4.8**	**4.7**	**14.8**	**14.7**		
Prob. Error.........	5.20	5.20	12.75	12.75		
	in	in	out	out		

TABLE 38

Monohybrid Frequency Distributions Obtained in the F_3 Progenies from F_2 Beardless, Red Chaff Parents That Were Heterozygous Beardless and Homozygous Red Chaff

	Beardless Red	Bearded Red	Beardless Red	Bearded Red	Beardless Red	Bearded Red
	13-3-2—87 plants		13-3-4—328 plants		13-3-8—137 plants	
	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**65**	**22**	**251**	**77**	**78**	**59**
Theoretical	65.3	21.8	246.0	82.0	102.8	34.3
Difference	**0.3**	**0.2**	**5.0**	**5.0**	**24.8**	**24.7**
Prob. Error.........	2.72	2.72	5.29	5.29	3.42	3.42
	in	in	in	in	out	out
	13-3-9—238 plants		13-3-10—245 plants		13-3-13—50 plants	
	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**173**	**65**	**176**	**69**	**37**	**13**
Theoretical	178.5	59.5	183.8	61.3	37.5	12.5
Difference	**5.5**	**5.5**	**7.8**	**7.7**	**0.5**	**0.5**
Prob. Error.........	4.51	4.51	4.57	4.57	2.07	2.07
	out	out	out	out	in	in
	13-3-16—118 plants		13-3-17—47 plants		13-3-19—41 plants	
	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**87**	**31**	**36**	**11**	**29**	**12**
Theoretical	88.5	29.5	35.3	11.8	30.8	10.3
Difference	**1.5**	**1.5**	**0.7**	**0.8**	**1.8**	**1.7**
Prob. Error.........	3.17	3.17	2.00	2.00	1.87	1.87
	in	in	in	in	in	in

TABLE 38 (Continued)

	Beardless Red	Bearded Red	Beardless Red	Bearded Red	Beardless Red	Bearded Red
	13-3-25—104 plants		13-3-28—180 plants		13-3-31—128 plants	
	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**77**	**27**	**130**	**50**	**95**	**33**
Theoretical	78.0	26.0	135.0	45.0	96.0	32.0
Difference	**1.0**	**1.0**	**5.0**	**5.0**	**1.0**	**1.0**
Prob. Error	2.98	2.98	3.92	3.92	3.30	3.30
	in	in	out	out	in	in
	13-3-36—57 plants		13-3-41—296 plants		13-3-42—416 plants	
	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**44**	**13**	**217**	**79**	**318**	**98**
Theoretical	42.8	14.3	222.0	74.0	312.0	104.0
Difference	**1.2**	**1.3**	**5.0**	**5.0**	**6.0**	**6.0**
Prob. Error	2.21	2.21	5.03	5.03	5.96	5.96
	in	in	in	in	out	out
	13-3-43—76 plants		13-3-51—263 plants		Total of all progenies—2811 plants	
	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**62**	**14**	**190**	**73**	**2065**	**746**
Theoretical	57.0	19.0	197.3	65.8	2108.3	702.8
Difference	**5.0**	**5.0**	**7.3**	**7.2**	**43.3**	**43.2**
Prob. Error	2.55	2.55	4.74	4.74	15.49	15.49
	out	out	out	out	out	out

TABLE 39

Monohybrid Frequency Distributions Obtained in the F_3 Progenies from F_2 Beardless, White Chaff Parents That Were Heterozygous Beardless

	Beardless White	Bearded White	Beardless White	Bearded White	Beardless White	Bearded White
	13-3-57—145 plants		13-3-58—131 plants		13-3-59—174 plants	
	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**119**	**26**	**95**	**36**	**131**	**43**
Theoretical	108.8	36.3	98.3	32.8	130.5	43.5
Difference	**10.2**	**10.3**	**3.3**	**3.2**	**0.5**	**0.5**
Prob. Error	3.52	3.52	3.34	3.34	3.85	3.85
	out	out	in	in	in	in
	13-3-61—41 plants		13-3-62—147 plants		13-3-63—35 plants	
	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**32**	**9**	**110**	**37**	**28**	**7**
Theoretical	30.8	10.3	110.3	36.8	26.3	8.8
Difference	**1.2**	**1.3**	**0.3**	**0.2**	**1.7**	**1.8**
Prob. Error	1.87	1.87	3.54	3.54	1.73	1.73
	in	in	in	in	out	out

TABLE 39 (Continued)

	Beardless White	Bearded White	Beardless White	Bearded White	Beardless White	Bearded White
	13-3-64—51 plants		13-3-65—26 plants		13-3-67—70 plants	
	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**36**	**15**	**19**	**7**	**57**	**13**
Theoretical	38.3	12.8	19.5	6.5	52.5	17.5
Difference	**2.3**	**2.2**	**0.5**	**0.5**	**4.5**	**4.5**
Prob. Error	2.09	2.09	1.49	1.49	2.44	2.44
	out	out	in	in	out	out
	13-3-68—36 plants		13-3-70—265 plants		13-3-72—114 plants	
	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**26**	**10**	**215**	**50**	**80**	**34**
Theoretical	27.0	9.0	198.8	66.3	85.5	28.5
Difference	**1.0**	**1.0**	**16.2**	**16.3**	**5.5**	**5.5**
Prob. Error	1.75	1.75	4.75	4.75	3.12	3.12
	in	in	out	out	out	out
	13-3-73—154 plants		Total of all progenies—1389 plants			
	(3)	(1)	(3)	(1)		
Observed	**109**	**45**	**1057**	**332**		
Theoretical	115.5	38.5	1041.8	347.3		
Difference	**6.5**	**6.5**	**15.2**	**15.3**		
Prob. Error	3.63	3.63	10.89	10.89		
	out	out	out	out		

TABLE 40

Monohybrid Frequency Distributions Obtained in the F_3 Progenies from F_2 Bearded, Red Chaff Parents That Were Heterozygous Red Chaff

	Bearded Red	Bearded White	Bearded Red	Bearded White	Bearded Red	Bearded White
	13-3-76—351 plants		13-3-79—271 plants		13-3-81—221 plants	
	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**265**	**86**	**206**	**65**	**155**	**66**
Theoretical	263.3	87.8	203.3	67.8	165.8	55.3
Difference	**1.7**	**1.8**	**2.7**	**2.8**	**10.8**	**10.7**
Prob. Error	5.47	5.47	4.81	4.81	4.34	4.34
	in	in	in	in	out	out
	13-3-82—92 plants		13-3-83—252 plants		13-3-85—134 plants	
	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**64**	**28**	**185**	**67**	**96**	**38**
Theoretical	69.0	23.0	189.0	63.0	100.5	33.5
Difference	**5.0**	**5.0**	**4.0**	**4.0**	**4.5**	**4.5**
Prob. Error	2.80	2.80	4.64	4.64	3.38	3.38
	out	out	in	in	out	out

TABLE 40 (Continued)

	Bearded Red	Bearded White	Bearded Red	Bearded White	Bearded Red	Bearded White
	13-3-86—81 plants		13-3-88—69 plants		13-3-89—171 plants	
	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**65**	**16**	**52**	**17**	**127**	**44**
Theoretical	60.8	20.3	51.8	17.3	128.3	42.8
Difference	**4.2**	**4.3**	**0.2**	**0.3**	**1.3**	**1.2**
Prob. Error	2.63	2.63	2.43	2.43	3.82	3.82
	out	out	in	in	in	in
	13-3-90—41 plants		13-3-91—172 plants		13-3-92—64 plants	
	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**30**	**11**	**127**	**45**	**49**	**15**
Theoretical	30.8	10.3	129.0	43.0	48.0	16.0
Difference	**0.8**	**0.7**	**2.0**	**2.0**	**1.0**	**1.0**
Prob. Error	1.87	1.87	3.83	3.83	2.34	2.34
	in	in	in	in	in	in
	13-3-94—84 plants		Total of all progenies—2003 plants			
	(3)	(1)	(3)	(1)		
Observed	**59**	**25**	**1480**	**523**		
Theoretical	63.0	21.0	1502.3	500.8		
Difference	**4.0**	**4.0**	**22.3**	**22.2**		
Prob. Error	2.68	2.68	13.07	13.07		
	out	out	out	out		

PROBABLE ERROR STUDIES ON THE F_3 GENERATION OF CROSS 16 HARVEST KING♀ × FULTZ MEDITERRANEAN♂

TABLE 41

Dihybrid Frequency Distributions Obtained in the F_3 Progenies From F_2 Red and Velvet Chaff Parents That Were Heterozygous With Respect to Both Characters

	Red Velvet Chaff	Red Smooth Chaff	White Velvet Chaff	White Smooth Chaff	Red Velvet Chaff	Red Smooth Chaff	White Velvet Chaff	White Smooth Chaff
	16-2-3—59 plants				16-2-4—29 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**35**	**12**	**7**	**5**	**22**	**2**	**3**	**2**
Theoretical	33.2	11.1	11.1	3.7	16.3	5.4	5.4	1.8
Difference	**1.8**	**0.9**	**4.1**	**1.3**	**5.7**	**3.4**	**2.4**	**0.2**
Prob. Error	2.57	2.02	2.02		1.80	1.42	1.42	
	in	in	out		out	out	out	
	16-2-5—58 plants				16-2-10—59 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**35**	**11**	**8**	**4**	**32**	**15**	**10**	**2**
Theoretical	32.6	10.9	10.9	3.6	33.2	11.1	11.1	3.7
Difference	**2.4**	**0.1**	**2.9**	**0.4**	**1.2**	**3.9**	**1.1**	**1.7**
Prob. Error	2.55	2.01	2.01		2.57	2.02	2.02	
	in	in	out		in	out	in	

TABLE 41 (Continued)

	Red Velvet Chaff	Red Smooth Chaff	White Velvet Chaff	White Smooth Chaff	Red Velvet Chaff	Red Smooth Chaff	White Velvet Chaff	White Smooth Chaff
	16-2-11—169 plants				16-2-12—135 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**103**	**27**	**27**	**12**	**75**	**34**	**19**	**7**
Theoretical ...	95.1	31.7	31.7	10.6	75.9	25.3	25.3	8.4
Difference	**7.9**	**4.7**	**4.7**	**1.4**	**0.9**	**8.7**	**6.3**	**1.4**
Prob. Error....	4.35	3.42	3.42		3.89	3.06	3.06	
	out	out	out		in	out	out	
	16-2-14—79 plants				16-2-15—79 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**50**	**14**	**11**	**4**	**37**	**20**	**17**	**5**
Theoretical ...	44.4	14.8	14.8	4.9	44.4	14.8	14.8	4.9
Difference	**5.6**	**0.8**	**3.8**	**0.9**	**7.4**	**5.2**	**2.2**	**0.1**
Prob. Error....	2.97	2.34	2.34		2.97	2.34	2.34	
	out	in	out		out	out	in	
	16-2-19—40 plants				16-2-24—43 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**18**	**10**	**9**	**3**	**29**	**6**	**8**	**0**
Theoretical ...	22.5	7.5	7.5	2.5	24.2	8.1	8.1	2.7
Difference	**4.5**	**2.5**	**1.5**	**0.5**	**4.8**	**2.1**	**0.1**	**2.7**
Prob. Error....	2.12	1.67	1.67		2.19	1.73	1.73	
	out	out	in		out	out	in	
	16-2-26—81 plants				Total of all progenies—831 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**47**	**15**	**17**	**2**	**483**	**166**	**136**	**46**
Theoretical ...	45.6	15.2	15.2	5.1	467.4	155.8	155.8	51.9
Difference	**1.4**	**0.2**	**1.8**	**3.1**	**15.6**	**10.2**	**19.8**	**5.9**
Prob. Error....	3.01	2.37	2.37		9.65	7.59	7.59	
	in	in	in		out	out	out	

TABLE 42

Monohybrid Frequency Distributions Obtained in the F_3 Progenies From F_2 Red and Velvet Chaff Parents That Were Heterozygous Velvet Chaff and Homozygous Red Chaff

	Red Velvet	Red Smooth	Red Velvet	Red Smooth	Red Velvet	Red Smooth	Red Velvet	Red Smooth
	16-2-8—45 plants		16-2-9—12 plants		16-2-16—110 plants		16-2-17—62 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**36**	**9**	**11**	**1**	**77**	**33**	**47**	**15**
Theoretical ...	33.8	11.3	9.0	3.0	82.5	27.5	46.5	15.5
Difference	**2.2**	**2.3**	**2.0**	**2.0**	**5.5**	**5.5**	**0.5**	**0.5**
Prob. Error....	1.96	1.96	1.01	1.01	3.06	3.06	2.30	2.30
	out	out	out	out	out	out	in	in

TABLE 42 (Continued)

	Red Velvet	Red Smooth	Red Velvet	Red Smooth	Red Velvet	Red Smooth	Red Velvet	Red Smooth
	16-2-20— 152 plants		16-2-23— 111 plants		Total of all progenies— 492 plants			
	(3)	(1)	(3)	(1)	(3)	(1)		
Observed	**100**	**52**	**88**	**23**	**359**	**133**		
Theoretical ...	114.0	38.0	83.3	27.8	369.0	123.0		
Difference	**14.0**	**14.0**	**4.7**	**4.8**	**10.0**	**10.0**		
Prob. Error....	3.60 out	3.60 out	3.08 out	3.08 out	6.48 out	6.48 out		

TABLE 43

Monohybrid Frequency Distributions Obtained in the F_3 Progenies From F_2 Red and Velvet Chaff Parents That Were Heterozygous Red Chaff and Homozygous Velvet Chaff

	Red Velvet	White Velvet	Red Velvet	White Velvet	Red Velvet	White Velvet	Red Velvet	White Velvet
	16-2-2— 111 plants		16-2-7— 104 plants		16-2-13— 72 plants		16-2-18— 9 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**83**	**28**	**75**	**29**	**53**	**19**	**8**	**1**
Theoretical ...	83.3	27.8	78.0	26.0	54.0	18.0	6.8	2.3
Difference	**0.3**	**0.2**	**3.0**	**3.0**	**1.0**	**1.0**	**1.2**	**1.3**
Prob. Error....	3.08 in	3.08 in	2.98 out	2.98 out	2.48 in	2.48 in	0.88 out	0.88 out
	16-2-21— 67 plants		16-2-22— 67 plants		Total of all progenies— 430 plants			
	(3)	(1)	(3)	(1)	(3)	(1)		
Observed	**51**	**16**	**51**	**16**	**321**	**109**		
Theoretical ...	50.3	16.8	50.3	16.8	322.5	107.5		
Difference	**0.7**	**0.8**	**0.7**	**0.8**	**1.5**	**1.5**		
Prob. Error....	2.39 in	2.39 in	2.39 in	2.39 in	6.06 in	6.06 in		

TABLE 44

Monohybrid Frequency Distributions Obtained in the F_3 Progenies From F_2 Red and Smooth Chaff Parents That Were Heterozygous Red Chaff

	Red Smooth	White Smooth	Red Smooth	White Smooth	Red Smooth	White Smooth	Red Smooth	White Smooth
	16-2-27— 72 plants		16-2-28— 60 plants		16-2-29— 78 plants		16-2-30— 49 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**57**	**15**	**38**	**22**	**56**	**22**	**36**	**13**
Theoretical	54.0	18.0	45.0	15.0	58.5	19.5	36.8	12.3
Difference	**3.0**	**3.0**	**7.0**	**7.0**	**2.5**	**2.5**	**0.8**	**0.7**
Prob. Error....	2.48 out	2.48 out	2.26 out	2.26 out	2.58 in	2.58 in	2.04 in	2.04 in

TABLE 44 (Continued)

	Red Smooth	White Smooth	Red Smooth	White Smooth	Red Smooth	White Smooth	Red Smooth	White Smooth
	16-2-31—116 plants		16-2-33—243 plants		16-2-34—162 plants		Total of all progenies—780 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**91**	**25**	**184**	**59**	**119**	**43**	**581**	**199**
Theoretical	87.0	29.0	182.3	60.8	121.5	40.5	585.0	195.0
Difference	**4.0**	**4.0**	**1.7**	**1.8**	**2.5**	**2.5**	**4.0**	**4.0**
Prob. Error....	3.15 out	3.15 out	4.55 in	4.55 in	3.72 in	3.72 in	8.16 in	8.16 in

TABLE 45

Monohybrid Frequency Distributions Obtained in the F_3 Progenies From F_2 White and Velvet Chaff Parents That Were Heterozygous Velvet Chaff

	Velvet White	Smooth White	Velvet White	Smooth White	Velvet White	Smooth White	Velvet White	Smooth White
	16-2-35—44 plants		16-2-36—130 plants		16-2-37—16 plants		16-2-39—100 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**37**	**7**	**104**	**26**	**9**	**7**	**71**	**29**
Theoretical	33.0	11.0	97.5	32.5	12.0	4.0	75.0	25.0
Difference	**4.0**	**4.0**	**6.5**	**6.5**	**3.0**	**3.0**	**4.0**	**4.0**
Prob. Error....	1.94 out	1.94 out	3.33 out	3.33 out	1.17 out	1.17 out	2.92 out	2.92 out
	16-2-41—172 plants		Total of all progenies—462 plts					
	(3)	(1)	(3)	(1)				
Observed	**138**	**34**	**359**	**103**				
Theoretical	129.0	43.0	346.5	115.5				
Difference	**9.0**	**9.0**	**12.5**	**12.5**				
Prob. Error....	3.83 out	3.83 out	6.28 out	6.28 out				

PROBABLE ERROR STUDIES ON THE F_3 GENERATION OF CROSS 19 TURKEY RED♀ × HARVEST KING♂

TABLE 46

Dihybrid Frequency Distributions Obtained in the F_3 Progenies from F_2 Beardless, Red Chaff Parents That Were Heterozygous With Respect to Both Characters

	Beardless Red	Beardless White	Bearded Red	Bearded White	Beardless Red	Beardless White	Bearded Red	Bearded White
	19-2-1—93 plants				19-2-4—248 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**56**	**15**	**17**	**5**	**135**	**50**	**54**	**9**
Theoretical ...	52.3	17.4	17.4	5.8	139.5	46.5	46.5	15.5
Difference	**3.7**	**2.4**	**0.4**	**0.8**	**4.5**	**3.5**	**7.5**	**6.5**
Prob. Error....	3.25 out	2.54 in	2.54 in		5.27 in	4.15 in	4.15 out	

TABLE 46 (Continued)

	Beardless Red	Beardless White	Bearded Red	Bearded White	Beardless Red	Beardless White	Bearded Red	Bearded White
	19-2-5—41 plants				19-2-8—95 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**20**	**11**	**8**	**2**	**47**	**22**	**19**	**7**
Theoretical ...	23.1	7.7	7.7	2.6	53.4	17.8	17.8	5.9
Difference	**3.1**	**3.3**	**0.3**	**0.6**	**6.4**	**4.2**	**1.2**	**1.1**
Prob. Error....	2.14	1.69	1.69		3.26	2.57	2.57	
	out	out	in		out	out	in	
	19-2-17—117 plants				19-2-24—75 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**70**	**20**	**23**	**4**	**38**	**19**	**13**	**5**
Theoretical ...	65.8	21.9	21.9	7.3	42.2	14.1	14.1	4.7
Difference	**4.2**	**1.9**	**1.1**	**3.3**	**4.2**	**4.9**	**1.1**	**0.3**
Prob. Error....	3.62	2.85	2.85		2.90	2.28	2.28	
	out	in	in		out	out	in	
	19-2-25—44 plants				19-2-36—81 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**24**	**8**	**8**	**4**	**44**	**14**	**18**	**5**
Theoretical ...	24.8	8.3	8.3	2.8	45.6	15.2	15.2	5.1
Difference	**0.8**	**0.3**	**0.3**	**1.2**	**1.6**	**1.2**	**2.8**	**0.1**
Prob. Error....	2.22	1.75	1.75		3.01	2.37	2.37	
	in	in	in		in	in	out	
	19-2-37—124 plants				19-2-40—66 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**73**	**16**	**27**	**8**	**36**	**11**	**14**	**5**
Theoretical ...	69.8	23.3	23.3	7.8	37.1	12.4	12.4	4.1
Difference	**3.2**	**7.3**	**3.7**	**0.2**	**1.1**	**1.4**	**1.6**	**0.9**
Prob. Error....	3.73	2.93	2.93		2.72	2.14	2.14	
	in	out	out		in	in	in	
	19-2-41—21 plants				19-2-47—63 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**11**	**3**	**6**	**1**	**31**	**16**	**11**	**5**
Theoretical ...	11.8	3.9	3.9	1.3	35.4	11.8	11.8	3.9
Difference	**0.8**	**0.9**	**2.1**	**0.3**	**4.4**	**4.2**	**0.8**	**1.1**
Prob. Error....	1.53	1.21	1.21		2.66	2.09	2.09	
	in	in	out		out	out	in	
	19-2-51—47 plants				19-2-54—73 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**27**	**10**	**6**	**4**	**38**	**13**	**18**	**4**
Theoretical ...	26.4	8.8	8.8	2.9	41.1	13.7	13.7	4.6
Difference	**0.6**	**1.2**	**2.8**	**1.1**	**3.1**	**0.7**	**4.3**	**0.6**
Prob. Error....	2.29	1.81	1.81		2.86	2.25	2.25	
	in	in	out		out	in	out	
	19-2-57—120 plants				19-2-58—145 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**82**	**17**	**16**	**5**	**86**	**26**	**26**	**7**
Theoretical ...	67.5	22.5	22.5	7.5	81.6	27.2	27.2	9.1
Difference	**14.5**	**5.5**	**6.5**	**2.5**	**4.4**	**1.2**	**1.2**	**2.1**
Prob. Error....	3.67	2.88	2.88		4.03	3.17	3.17	
	out	out	out		out	in	in	

TABLE 46 (Continued)

	Beardless Red	Beardless White	Bearded Red	Bearded White	Beardless Red	Beardless White	Bearded Red	Bearded White
	19-2-60—174 plants				19-2-62—33 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**107**	**21**	**42**	**4**	**19**	**6**	**5**	**3**
Theoretical	97.9	32.6	32.6	10.9	18.6	6.2	6.2	2.1
Difference	**9.1**	**11.6**	**9.4**	**6.9**	**0.4**	**0.2**	**1.2**	**0.9**
Prob. Error	4.41	3.47	3.47		1.92	1.51	1.51	
	out	out	out		in	in	in	
	19-2-63—22 plants				19-2-64—44 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**12**	**4**	**4**	**2**	**20**	**15**	**7**	**2**
Theoretical	12.4	4.1	4.1	1.4	24.8	8.3	8.3	2.8
Difference	**0.4**	**0.1**	**0.1**	**0.6**	**4.8**	**6.7**	**1.3**	**0.8**
Prob. Error	1.57	1.24	1.24		2.22	1.75	1.75	
	in	in	in		out	out	in	
	19-2-65—98 plants				19-2-67—21 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**55**	**14**	**21**	**8**	**16**	**3**	**1**	**1**
Theoretical	55.1	18.4	18.4	6.1	11.8	3.9	3.9	1.3
Difference	**0.1**	**4.4**	**2.6**	**1.9**	**4.2**	**0.9**	**2.9**	**0.3**
Prob. Error	3.31	2.61	2.61		1.53	1.21	1.21	
	in	out	in		out	in	out	
	19-2-68—60 plants				19-2-71—95 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**42**	**3**	**15**	**0**	**57**	**21**	**13**	**4**
Theoretical	33.8	11.3	11.3	3.8	53.4	17.8	17.8	5.9
Difference	**8.2**	**8.3**	**3.7**	**3.8**	**3.6**	**3.2**	**4.8**	**1.9**
Prob. Error	2.59	2.04	2.04		3.26	2.57	2.57	
	out	out	out		out	out	out	
	19-2-72—44 plants				19-2-76—94 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**26**	**7**	**8**	**3**	**47**	**17**	**19**	**11**
Theoretical	24.8	8.3	8.3	2.8	52.9	17.6	17.6	5.9
Difference	**1.2**	**1.3**	**0.3**	**0.2**	**5.9**	**0.6**	**1.4**	**5.1**
Prob. Error	2.22	1.75	1.75		3.24	2.55	2.55	
	in	in	in		out	in	in	
	19-2-78—28 plants				19-2-86—97 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**14**	**7**	**5**	**2**	**56**	**23**	**14**	**4**
Theoretical	15.8	5.3	5.3	1.8	54.6	18.2	18.2	6.1
Difference	**1.8**	**1.7**	**0.3**	**0.2**	**1.4**	**4.8**	**4.2**	**2.1**
Prob. Error	1.77	1.39	1.39		3.30	2.59	2.59	
	out	out	in		in	out	out	
	Total of all progenies including 4 with less than 16 population—2300 plants							
	(9)	(3)	(3)	(1)				
Observed	**1314**	**418**	**444**	**124**				
Theoretical	1293.8	431.3	431.3	143.8				
Difference	**20.2**	**13.3**	**12.7**	**19.8**				
Prob. Error	16.05	12.63	12.63					
	out	out	out					

TABLE 47

Monohybrid Frequency Distributions Obtained in the F_3 Progenies From F_2 Beardless, Red Chaff Parents That Were Heterozygous Red Chaff and Homozygous Beardless

	Beardless Red	Beardless White	Beardless Red	Beardless White	Beardless Red	Beardless White
	19-2-2— 90 plants		19-2-3— 68 plants		19-2-7— 53 plants	
	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**58**	**32**	**51**	**17**	**33**	**20**
Theoretical	67.5	22.5	51.0	17.0	39.8	13.3
Difference	**9.5**	**9.5**	**0.0**	**0.0**	**6.8**	**6.7**
Prob. Error	2.77	2.77	2.41	2.41	2.13	2.13
	out	out	in	in	out	out
	19-2-9— 101 plants		19-2-10— 82 plants		19-2-11— 60 plants	
	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**82**	**19**	**65**	**17**	**43**	**17**
Theoretical	75.8	25.3	61.5	20.5	45.0	15.0
Difference	**6.2**	**6.3**	**3.5**	**3.5**	**2.0**	**2.0**
Prob. Error	2.94	2.94	2.65	2.65	2.26	2.26
	out	out	out	out	in	in
	19-2-12— 66 plants		19-2-13— 10 plants		19-2-18— 229 plants	
	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**54**	**12**	**7**	**3**	**177**	**52**
Theoretical	49.5	16.5	7.5	2.5	171.8	57.3
Difference	**4.5**	**4.5**	**0.5**	**0.5**	**5.2**	**5.3**
Prob. Error	2.37	2.37	0.92	0.92	4.42	4.42
	out	out	in	in	out	out
	19-2-28— 72 plants		19-2-34— 20 plants		19-2-35— 70 plants	
	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**51**	**21**	**17**	**3**	**49**	**21**
Theoretical	54.0	18.0	15.0	5.0	52.5	17.5
Difference	**3.0**	**3.0**	**2.0**	**2.0**	**3.5**	**3.5**
Prob. Error	2.48	2.48	1.31	1.31	2.44	2.44
	out	out	out	out	out	out
	19-2-44— 55 plants		19-2-46— 137 plants		19-2-56— 185 plants	
	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**37**	**18**	**102**	**35**	**141**	**44**
Theoretical	41.3	13.8	102.8	34.3	138.8	46.3
Difference	**4.3**	**4.2**	**0.8**	**0.7**	**2.2**	**2.3**
Prob. Error	2.17	2.17	3.42	3.42	3.97	3.97
	out	out	in	in	in	in
	19-2-77— 104 plants		19-2-80— 75 plants		19-2-82— 31 plants	
	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**78**	**26**	**59**	**16**	**20**	**11**
Theoretical	78.0	26.0	56.3	18.8	23.3	7.8
Difference	**0.0**	**0.0**	**2.7**	**2.8**	**3.3**	**3.2**
Prob. Error	2.98	2.98	2.53	2.53	1.63	1.63
	in	in	out	out	out	out

TABLE 47 (Continued)

	Beardless Red	Beardless White	Beardless Red	Beardless White	Beardless Red	Beardless White
	19-2-83—16 plants		19-2-84—132 plants		Total of all progenies—1656 plants	
	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**12**	**4**	**100**	**32**	**1236**	**420**
Theoretical	12.0	4.0	99.0	33.0	1242.0	414.0
Difference	**0.0**	**0.0**	**1.0**	**1.0**	**6.0**	**6.0**
Prob. Error	1.17	1.17	3.36	3.36	11.89	11.89
	in	in	in	in	in	in

TABLE 48

Monohybrid Frequency Distributions Obtained in the F_3 Progenies From F_2 Beardless, Red Chaff Parents That Were Heterozygous Beardless and Homozygous Red.

	Beardless Red	Bearded Red	Beardless Red	Bearded Red	Beardless Red	Bearded Red	Beardless Red	Bearded Red
	19-2-14—166 plants		19-2-16—56 plants		19-2-19—71 plants		19-2-26—37 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**128**	**38**	**38**	**18**	**63**	**8**	**28**	**9**
Theoretical	124.5	41.5	42.0	14.0	53.3	17.8	27.8	9.3
Difference	**3.5**	**3.5**	**4.0**	**4.0**	**9.7**	**9.8**	**0.2**	**0.3**
Prob. Error	3.76	3.76	2.19	2.19	2.46	2.46	1.78	1.78
	in	in	out	out	out	out	in	in
	19-2-29—31 plants		19-2-31—72 plants		19-2-32—208 plants		19-2-33—202 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**23**	**8**	**60**	**12**	**144**	**64**	**135**	**67**
Theoretical	23.3	7.8	54.0	18.0	156.0	52.0	151.5	50.5
Difference	**0.3**	**0.2**	**6.0**	**6.0**	**12.0**	**12.0**	**16.5**	**16.5**
Prob. Error	1.63	1.63	2.48	2.48	4.21	4.21	4.15	4.15
	in	in	out	out	out	out	out	out
	19-2-38—74 plants		19-2-39—45 plants		19-2-43—29 plants		19-2-45—81 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**56**	**18**	**33**	**12**	**25**	**4**	**55**	**26**
Theoretical	55.5	18.5	33.8	11.3	21.8	7.3	60.8	20.3
Difference	**0.5**	**0.5**	**0.8**	**0.7**	**3.2**	**3.3**	**5.8**	**5.7**
Prob. Error	2.51	2.51	1.96	1.96	1.57	1.57	2.63	2.63
	in	in	in	in	out	out	out	out
	19-2-48—17 plants		19-2-49—25 plants		19-2-59—153 plants		19-2-61—28 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**13**	**4**	**20**	**5**	**120**	**33**	**20**	**8**
Theoretical	12.8	4.3	18.8	6.3	114.8	38.3	21.0	7.0
Difference	**0.2**	**0.3**	**1.2**	**1.3**	**5.2**	**5.3**	**1.0**	**1.0**
Prob. Error	1.20	1.20	1.46	1.46	3.61	3.61	1.55	1.55
	in	in	in	in	out	out	in	in

TABLE 48 (Continued)

	Beardless Red	Bearded Red	Beardless Red	Bearded Red	Beardless Red	Bearded Red	Beardless Red	Bearded Red
	19-2-66— 57 plants		19-2-69— 82 plants		19-2-73— 64 plants		19-2-74— 94 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**40**	**17**	**60**	**22**	**42**	**22**	**77**	**17**
Theoretical	42.8	14.3	61.5	20.5	48.0	16.0	70.5	23.5
Difference	**2.8**	**2.7**	**1.5**	**1.5**	**6.0**	**6.0**	**6.5**	**6.5**
Prob. Error....	2.21	2.21	2.65	2.65	2.34	2.34	2.83	2.83
	out	out	in	in	out	out	out	out
	19-2-85— 113 plants		Total of all progenies— 1705 plants					
	(3)	(1)	(3)	(1)				
Observed	**90**	**23**	**1270**	**435**				
Theoretical	84.8	28.3	1278.8	426.3				
Difference	**5.2**	**5.3**	**8.8**	**8.7**				
Prob. Error....	3.11	3.11	12.06	12.06				
	out	out	in	in				

TABLE 49

Monohybrid Frequency Distributions Obtained in the F_3 Progenies From F_2 Beardless, White Chaff Parents That Were Heterozygous Beardless

	Beardless White	Bearded White	Beardless White	Bearded White	Beardless White	Bearded White	Beardless White	Bearded White
	19-2-88— 32 plants		19-2-89— 144 plants		19-2-90— 162 plants		19-2-92— 129 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**26**	**6**	**117**	**27**	**120**	**42**	**93**	**36**
Theoretical	24.0	8.0	108.0	36.0	121.5	40.5	96.8	32.3
Difference	**2.0**	**2.0**	**9.0**	**9.0**	**1.5**	**1.5**	**3.8**	**3.7**
Prob. Error....	1.65	1.65	3.51	3.51	3.72	3.72	3.32	3.32
	out	out	out	out	in	in	out	out
	19-2-94— 103 plants		19-2-95— 11 plants		19-2-99— 118 plants		19-2-100— 36 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**71**	**32**	**7**	**4**	**95**	**23**	**22**	**14**
Theoretical	77.3	25.8	8.3	2.8	88.5	29.5	27.0	9.0
Difference	**6.3**	**6.2**	**1.3**	**1.2**	**6.5**	**6.5**	**5.0**	**5.0**
Prob. Error....	2.96	2.96	0.97	0.97	3.17	3.17	1.75	1.75
	out	out	out	out	out	out	out	out
	19-2-101— 163 plants		19-2-103— 50 plants		Total of all progenies— 948 plants			
	(3)	(1)	(3)	(1)	(3)	(1)		
Observed	**107**	**56**	**38**	**12**	**696**	**252**		
Theoretical	122.3	40.8	37.5	12.5	711.0	237.0		
Difference	**15.3**	**15.2**	**0.5**	**0.5**	**15.0**	**15.0**		
Prob. Error....	3.73	3.73	2.07	2.07	8.99	8.99		
	out	out	in	in	out	out		

TABLE 50

Monohybrid Frequency Distributions Obtained in the F_3 Progenies From F_2 Bearded, Red Chaff Parents That Were Heterozygous Red Chaff

	Bearded Red	Bearded White	Bearded Red	Bearded White	Bearded Red	Bearded White	Bearded Red	Bearded White
	19-2-108— 24 plants		19-2-109— 18 plants		19-2-110— 103 plants		19-2-112— 11 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**19**	**5**	**15**	**3**	**74**	**29**	**6**	**5**
Thoeretical	18.0	6.0	13.5	4.5	77.3	25.8	8.3	2.8
Difference	**1.0**	**1.0**	**1.5**	**1.5**	**3.3**	**3.2**	**2.3**	**2.2**
Prob. Error....	1.43	1.43	1.24	1.24	2.96	2.96	0.97	0.97
	in	in	out	out	out	out	out	out
	19-2-115— 97 plants		19-2-116— 96 plants		19-2-117— 205 plants		19-2-121— 15 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**68**	**29**	**58**	**38**	**167**	**38**	**11**	**4**
Theoretical	72.8	24.3	72.0	24.0	153.8	51.3	11.3	3.8
Difference	**4.8**	**4.7**	**14.0**	**14.0**	**13.2**	**13.3**	**0.3**	**0.2**
Prob. Error....	2.88	2.88	2.86	2.86	4.18	4.18	1.13	1.13
	out	out	out	out	out	out	in	in
	19-2-123— 240 plants		19-2-124— 139 plants		Total of all progenies— 948 plants			
	(3)	(1)	(3)	(1)	(3)	(1)		
Observed	**184**	**56**	**103**	**36**	**705**	**243**		
Theoretical	180.0	60.0	104.3	34.8	711.0	237.0		
Difference	**4.0**	**4.0**	**1.3**	**1.2**	**6.0**	**6.0**		
Prob. Error....	4.52	4.52	3.44	3.44	8.99	8.99		
	in	in	in	in	in	in		

PROBABLE ERROR STUDIES ON THE F_3 GENERATION OF CROSS 24 TURKEY RED♀ × FULTZ MEDITERRANEAN♂

TABLE 51

Monohybrid Frequency Distributions Obtained in the F_3 Progenies From F_2 Beardless Parents That Were Heterozygous Beardless

	Beardless	Bearded	Beardless	Bearded	Beardless	Bearded	Beardless	Bearded
	24-1-1— 47 plants		24-1-3— 82 plants		24-1-7— 74 plants		24-1-8— 13 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**37**	**10**	**68**	**14**	**55**	**19**	**9**	**4**
Theoretical	35.3	11.8	61.5	20.5	55.5	18.5	9.8	3.3
Difference	**1.7**	**1.8**	**6.5**	**6.5**	**0.5**	**0.5**	**0.8**	**0.7**
Prob. Error....	2.00	2.00	2.65	2.65	2.51	2.51	1.05	1.05
	in	in	out	out	in	in	in	in

TABLE 51 (Continued)

	Beard-less	Beard-ed	Beard-less	Beard-ed	Beard-less	Beard-ed	Beard-less	Beard-ed
	24-1-9— 22 plants		24-1-12— 43 plants		24-1-13— 27 plants		24-1-14— 147 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**17**	**5**	**33**	**10**	**22**	**5**	**114**	**33**
Theoretical	16.5	5.5	32.3	10.8	20.3	6.8	110.3	36.8
Difference	**0.5**	**0.5**	**0.7**	**0.8**	**1.7**	**1.8**	**3.7**	**3.8**
Prob. Error....	1.37	1.37	1.92	1.92	1.52	1.52	3.54	3.54
	in	in	in	in	out	out	out	out
	24-1-15— 46 plants		24-1-17— 17 plants		24-1-18— 20 plants		24-1-19— 36 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**41**	**5**	**12**	**5**	**12**	**8**	**27**	**9**
Theoretical	34.5	11.5	12.8	4.3	15.0	5.0	27.0	9.0
Difference	**6.5**	**6.5**	**0.8**	**0.7**	**3.0**	**3.0**	**0.0**	**0.0**
Prob. Error....	1.98	1.98	1.20	1.20	1.31	1.31	1.75	1.75
	out	out	in	in	out	out	in	in
	24-1-21— 34 plants		24-1-22— 132 plants		24-1-23— 98 plants		24-1-25— 244 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**25**	**9**	**110**	**22**	**81**	**17**	**190**	**54**
Theoretical	25.5	8.5	99.0	33.0	73.5	24.5	183.0	61.0
Difference	**0.5**	**0.5**	**11.0**	**11.0**	**7.5**	**7.5**	**7.0**	**7.0**
Prob. Error....	1.70	1.70	3.36	3.36	2.89	2.89	4.56	4.56
	in	in	out	out	out	out	out	out
	24-1-27— 40 plants		24-1-31— 13 plants		24-1-32— 12 plants		24-1-33— 90 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**31**	**9**	**11**	**2**	**8**	**4**	**72**	**18**
Theoretical	30.0	10.0	9.8	3.3	9.0	3.0	67.5	22.5
Difference	**1.0**	**1.0**	**1.2**	**1.3**	**1.0**	**1.0**	**4.5**	**4.5**
Prob. Error....	1.85	1.85	1.05	1.05	1.01	1.01	2.77	2.77
	in	in	out	out	in	in	out	out
	24-1-35— 276 plants		24-1-36— 41 plants		24-1-37— 81 plants		24-1-38— 133 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**213**	**63**	**27**	**14**	**66**	**15**	**95**	**38**
Theoretical ...	207.0	69.0	30.8	10.3	60.8	20.3	99.8	33.3
Difference	**6.0**	**6.0**	**3.8**	**3.7**	**5.2**	**5.3**	**4.8**	**4.7**
Prob. Error....	4.85	4.85	1.87	1.87	2.63	2.63	3.37	3.37
	out	out	out	out	out	out	out	out
	24-1-39— 33 plants		24-1-40— 72 plants		24-1-41— 15 plants		24-1-43— 170 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**25**	**8**	**52**	**20**	**12**	**3**	**121**	**49**
Theoretical	24.8	8.3	54.0	18.0	11.3	3.8	127.5	42.5
Difference	**0.2**	**0.3**	**2.0**	**2.0**	**0.7**	**0.8**	**6.5**	**6.5**
Prob. Error....	1.68	1.68	2.48	2.48	1.13	1.13	3.81	3.81
	in	in	in	in	in	in	out	out

TABLE 51 (Continued)

	Beardless	Bearded	Beardless	Bearded	Beardless	Bearded	Beardless	Bearded
	24-1-44— 11 plants		24-1-46— 56 plants		24-1-47— 112 plants		24-1-48— 101 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**9**	**2**	**42**	**14**	**77**	**35**	**86**	**15**
Theoretical	8.3	2.8	42.0	14.0	84.0	28.0	75.8	25.3
Difference	**0.7**	**0.8**	**0.0**	**0.0**	**7.0**	**7.0**	**10.2**	**10.3**
Prob. Error....	0.97	0.97	2.19	2.19	3.09	3.09	2.94	2.94
	in	in	in	in	out	out	out	out
	24-1-49— 61 plants		24-1-51— 24 plants		24-1-52— 53 plants		24-1-55— 92 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**45**	**16**	**16**	**8**	**42**	**11**	**79**	**13**
Theoretical	45.8	15.3	18.0	6.0	39.8	13.3	69.0	23.0
Difference	**0.8**	**0.7**	**2.0**	**2.0**	**2.2**	**2.3**	**10.0**	**10.0**
Prob. Error....	2.28	2.28	1.43	1.43	2.13	2.13	2.80	2.80
	in	in	out	out	out	out	out	out
	24-1-56— 97 plants		24-1-57— 22 plants		24-1-58— 91 plants		24-1-60— 69 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**72**	**25**	**16**	**6**	**66**	**25**	**51**	**18**
Theoretical	72.8	24.3	16.5	5.5	68.3	22.8	51.8	17.3
Difference	**0.8**	**0.7**	**0.5**	**0.5**	**2.3**	**2.2**	**0.8**	**0.7**
Prob. Error....	2.88	2.88	1.37	1.37	2.79	2.79	2.43	2.43
	in	in	in	in	in	in	in	in
	24-1-61— 112 plants		24-1-62— 12 plants		24-1-64— 102 plants		24-1-65— 35 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**88**	**24**	**10**	**2**	**77**	**25**	**26**	**9**
Theoretical	84.0	28.0	9.0	3.0	76.5	25.5	26.3	8.8
Difference	**4.0**	**4.0**	**1.0**	**1.0**	**0.5**	**0.5**	**0.3**	**0.2**
Prob. Error....	3.09	3.09	1.01	1.01	2.95	2.95	1.73	1.73
	out	out	in	in	in	in	in	in
	24-1-66— 54 plants		24-1-68— 41 plants		24-1-69— 63 plants		24-1-74— 82 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**36**	**18**	**30**	**11**	**49**	**14**	**60**	**22**
Theoretical	40.5	13.5	30.8	10.3	47.3	15.8	61.5	20.5
Difference	**4.5**	**4.5**	**0.8**	**0.7**	**1.7**	**1.8**	**1.5**	**1.5**
Prob. Error....	2.15	2.15	1.87	1.87	2.32	2.32	2.65	2.65
	out	out	in	in	in	in	in	in
	24-1-77— 13 plants		24-1-78— 163 plants		24-1-79— 102 plants		24-1-80— 85 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**11**	**2**	**120**	**43**	**73**	**29**	**63**	**22**
Theoretical	9.8	3.3	122.3	40.8	76.5	25.5	63.8	21.3
Difference	**1.2**	**1.3**	**2.3**	**2.2**	**3.5**	**3.5**	**0.8**	**0.7**
Prob. Error....	1.05	1.05	3.73	3.73	2.95	2.95	2.69	2.69
	out	out	in	in	out	out	in	in

TABLE 51 (Continued)

	Beard-less	Beard-ed	Beard-less	Beard-ed	Beard-less	Beard-ed	Beard-less	Beard-ed
	24-1-81— 25 plants		24-1-82— 28 plants		24-1-83— 24 plants		24-1-85— 145 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**20**	**5**	**23**	**5**	**19**	**5**	**106**	**39**
Theoretical	18.8	6.3	21.0	7.0	18.0	6.0	108.8	36.3
Difference	**1.2**	**1.3**	**2.0**	**2.0**	**1.0**	**1.0**	**2.8**	**2.7**
Prob. Error....	1.46	1.46	1.55	1.55	1.43	1.43	3.52	3.52
	in	in	out	out	in	in	in	in
	24-1-87— 45 plants		24-1-89— 33 plants		24-1-90— 43 plants		24-1-91— 25 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**32**	**13**	**23**	**10**	**34**	**9**	**19**	**6**
Theoretical	33.8	11.3	24.8	8.3	32.3	10.8	18.8	6.3
Difference	**1.8**	**1.7**	**1.8**	**1.7**	**1.7**	**1.8**	**0.2**	**0.3**
Prob. Error....	1.96	1.96	1.68	1.68	1.92	1.92	1.46	1.46
	in	in	out	out	in	in	in	in
	24-1-92— 27 plants		24-1-97— 13 plants		24-1-101— 52 plants		24-1-102— 216 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**20**	**7**	**10**	**3**	**42**	**10**	**153**	**63**
Theoretical	20.3	6.8	9.8	3.3	39.0	13.0	162.0	54.0
Difference	**0.3**	**0.2**	**0.2**	**0.3**	**3.0**	**3.0**	**9.0**	**9.0**
Prob. Error....	1.52	1.52	1.05	1.05	2.11	2.11	4.29	4.29
	in	in	in	in	out	out	out	out
	24-1-104— 95 plants		24-1-106— 24 plants		24-1-107— 85 plants		24-1-108— 75 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**69**	**26**	**18**	**6**	**59**	**26**	**53**	**22**
Theoretical	71.3	23.8	18.0	6.0	63.8	21.3	56.3	18.8
Difference	**2.3**	**2.2**	**0.0**	**0.0**	**4.8**	**4.7**	**3.3**	**3.2**
Prob. Error....	2.85	2.85	1.43	1.43	2.69	2.69	2.53	2.53
	in	in	in	in	out	out	out	out
	24-1-111— 30 plants		24-1-113— 12 plants		24-1-116— 155 plants		24-1-119— 35 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**22**	**8**	**7**	**5**	**114**	**41**	**26**	**9**
Theoretical	22.5	7.5	9.0	3.0	116.3	38.8	26.3	8.8
Difference	**0.5**	**0.5**	**2.0**	**2.0**	**2.3**	**2.2**	**0.3**	**0.2**
Prob. Error....	1.60	1.60	1.01	1.01	3.64	3.64	1.73	1.73
	in	in	out	out	in	in	in	in
	24-1-120— 11 plants		24-1-121— 197 plants		24-1-122— 15 plants		24-1-126— 26 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**8**	**3**	**148**	**49**	**10**	**5**	**20**	**6**
Theoretical	8.3	2.8	147.8	49.3	11.3	3.8	19.5	6.5
Difference	**0.3**	**0.2**	**0.2**	**0.3**	**1.3**	**1.2**	**0.5**	**0.5**
Prob. Error....	0.97	0.97	4.10	4.10	1.13	1.13	1.49	1.49
	in	in	in	in	out	out	in	in

TABLE 51 (Continued)

	Beardless	Bearded	Beardless	Bearded	Beardless	Bearded	Beardless	Bearded
	24-1-127— 188 plants		24-1-129— 24 plants		24-1-130— 60 plants		24-1-133— 137 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**134**	**54**	**15**	**9**	**49**	**11**	**97**	**40**
Theoretical	141.0	47.0	18.0	6.0	45.0	15.0	102.8	34.3
Difference	**7.0**	**7.0**	**3.0**	**3.0**	**4.0**	**4.0**	**5.8**	**5.7**
Prob. Error....	4.00	4.00	1.43	1.43	2.26	2.26	3.42	3.42
	out	out	out	out	out	out	out	out
	24-1-134— 100 plants		24-1-135— 135 plants		24-1-136— 17 plants		24-1-137— 123 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**67**	**33**	**94**	**41**	**10**	**7**	**91**	**32**
Theoretical	75.0	25.0	101.3	33.8	12.8	4.3	92.3	30.8
Difference	**8.0**	**8.0**	**7.3**	**7.2**	**2.8**	**2.7**	**1.3**	**1.2**
Prob. Error....	2.92	2.92	3.39	3.39	1.20	1.20	3.24	3.24
	out	out	out	out	out	out	in	in
	24-1-138— 87 plants		24-1-141— 52 plants		24-1-143— 145 plants		24-1-144— 59 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**65**	**22**	**33**	**19**	**103**	**42**	**47**	**12**
Theoretical	65.3	21.8	39.0	13.0	108.8	36.3	44.3	14.8
Difference	**0.3**	**0.2**	**6.0**	**6.0**	**5.8**	**5.7**	**2.7**	**2.8**
Prob. Error....	2.72	2.72	2.11	2.11	3.52	3.52	2.24	2.24
	in	in	out	out	out	out	out	out
	24-1-146— 182 plants		24-1-150— 48 plants		24-1-152— 29 plants		24-1-154— 70 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**140**	**42**	**43**	**5**	**27**	**2**	**53**	**17**
Theoretical	136.5	45.5	36.0	12.0	21.8	7.3	52.5	17.5
Difference	**3.5**	**3.5**	**7.0**	**7.0**	**5.2**	**5.3**	**0.5**	**0.5**
Prob. Error....	3.94	3.94	2.02	2.02	1.57	1.57	2.44	2.44
	in	in	out	out	out	out	in	in
	24-1-156— 193 plants		24-1-157— 309 plants		24-1-160— 67 plants		24-1-161— 24 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**150**	**43**	**228**	**81**	**53**	**14**	**18**	**6**
Theoretical	144.8	48.3	231.8	77.3	50.3	16.8	18.0	6.0
Difference	**5.2**	**5.3**	**3.8**	**3.7**	**2.7**	**2.8**	**0.0**	**0.0**
Prob. Error....	4.06	4.06	5.13	5.13	2.39	2.39	1.43	1.43
	out	out	in	in	out	out	in	in
	24-1-162— 239 plants		24-1-163— 136 plants		24-1-164— 172 plants		Total of all progenies — 7748 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**166**	**73**	**102**	**34**	**132**	**40**	**5805**	**1943**
Theoretical	179.3	59.8	102.0	34.0	129.0	43.0	5811.0	1937.0
Difference	**13.3**	**13.2**	**0.0**	**0.0**	**3.0**	**3.0**	**6.0**	**6.0**
Prob. Error....	4.52	4.52	3.41	3.41	3.83	3.83	25.71	25.71
	out	out	in	in	in	in	in	in

PROBABLE ERROR STUDIES ON THE F_3 GENERATION OF CROSS 30 CALIFORNIA♀ × BEARDLESS♂

TABLE 52

Monohybrid Frequency Distributions Obtained in the F_3 Progenies From F_2 Hooded Parents That Were Heterozygous Hooded

	Hooded	Bearded	Hooded	Bearded	Hooded	Bearded	Hooded	Bearded
	30-0-1— 396 Plants		30-0-3— 131 plants		30-0-4— 305 plants		30-0-5— 319 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**282**	**114**	**95**	**36**	**223**	**82**	**238**	**81**
Theoretical	297.0	99.0	98.3	32.8	228.8	76.3	239.3	79.8
Difference	**15.0**	**15.0**	**3.3**	**3.2**	**5.8**	**5.7**	**1.3**	**1.2**
Prob. Error....	5.81	5.81	3.34	3.34	5.10	5.10	5.22	5.22
	out	out	in	in	out	out	in	in
	30-0-8— 318 plants		30-0-10— 352 plants		30-0-11— 206 plants		30-0-12— 417 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**232**	**86**	**268**	**84**	**153**	**53**	**309**	**108**
Theoretical	238.5	79.5	264.0	88.0	154.5	51.5	312.8	104.3
Difference	**6.5**	**6.5**	**4.0**	**4.0**	**1.5**	**1.5**	**3.8**	**3.7**
Prob. Error....	5.21	5.21	5.48	5.48	4.19	4.19	5.96	5.96
	out	out	in	in	in	in	in	in
	30-0-14— 172 plants		30-0-15— 344 plants		30-0-18— 324 plants		30-0-19— 150 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**126**	**46**	**258**	**86**	**243**	**81**	**115**	**35**
Theoretical	129.0	43.0	258.0	86.0	243.0	81.0	112.5	37.5
Difference	**3.0**	**3.0**	**0.0**	**0.0**	**0.0**	**0.0**	**2.5**	**2.5**
Prob. Error....	3.83	3.83	5.42	5.42	5.26	5.26	3.58	3.58
	in	in	in	in	in	in	in	in
	30-0-20— 229 plants		30-0-22— 445 plants		30-0-23— 355 plants		30-0-24— 163 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**166**	**63**	**319**	**126**	**265**	**90**	**117**	**46**
Theoretical	171.8	57.3	333.8	111.3	266.3	88.8	122.3	40.8
Difference	**5.8**	**5.7**	**14.8**	**14.7**	**1.3**	**1.2**	**5.3**	**5.2**
Prob. Error....	4.42	4.42	6.16	6.16	5.50	5.50	3.73	3.73
	out	out	out	out	in	in	out	out
	30-0-26— 152 plants		30-0-27— 221 plants		30-0-28— 152 plants		30-0-29— 177 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**117**	**35**	**172**	**49**	**112**	**40**	**135**	**42**
Theoretical	114.0	38.0	165.8	55.3	114.0	38.0	132.8	44.3
Difference	**3.0**	**3.0**	**6.2**	**6.3**	**2.0**	**2.0**	**2.2**	**2.3**
Prob. Error....	3.60	3.60	4.34	4.34	3.60	3.60	3.89	3.89
	in	in	out	out	in	in	in	in

TABLE 52 (Continued)

	Hooded	Bearded	Hooded	Bearded	Hooded	Bearded	Hooded	Bearded
	30-0-30— 155 plants		30-0-31— 214 plants		30-0-32— 211 plants		30-0-33— 152 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**109**	**46**	**158**	**56**	**154**	**57**	**114**	**38**
Theoretical	116.3	38.8	160.5	53.5	158.3	52.8	114.0	38.0
Difference	**7.3**	**7.2**	**2.5**	**2.5**	**4.3**	**4.2**	**0.0**	**0.0**
Prob. Error....	3.64	3.64	4.27	4.27	4.24	4.24	3.60	3.60
	out	out	in	in	out	out	in	in
	30-0-34— 301 plants		30-0-36— 457 plants		30-0-37— 120 plants		30-0-38— 181 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**226**	**75**	**332**	**125**	**84**	**36**	**138**	**43**
Theoretical	225.8	75.3	342.8	114.3	90.0	30.0	135.8	45.3
Difference	**0.2**	**0.3**	**10.8**	**10.7**	**6.0**	**6.0**	**2.2**	**2.3**
Prob. Error....	5.07	5.07	6.24	6.24	3.20	3.20	3.93	3.93
	in	in	out	out	out	out	in	in
	30-0-39— 59 plants		30-0-40— 357 plants		30-0-41— 285 plants		30-0-45— 302 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**37**	**22**	**273**	**84**	**210**	**75**	**231**	**71**
Theoretical	44.3	14.8	267.8	89.3	213.8	71.3	226.5	75.5
Difference	**7.3**	**7.2**	**5.2**	**5.3**	**3.8**	**3.7**	**4.5**	**4.5**
Prob. Error....	2.24	2.24	5.52	5.52	4.93	4.93	5.08	5.08
	out	out	in	in	in	in	in	in
	30-0-46— 360 plants		30-0-47— 419 plants		30-0-49— 247 plants		30-0-51— 159 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**234**	**126**	**321**	**98**	**186**	**61**	**113**	**46**
Theoretical	270.0	90.0	314.3	104.8	185.3	61.8	119.3	39.8
Difference	**36.0**	**36.0**	**6.7**	**6.8**	**0.7**	**0.8**	**6.3**	**6.2**
Prob. Error....	5.54	5.54	5.98	5.98	4.59	4.59	3.68	3.68
	out	out	out	out	in	in	out	out
	30-0-52— 206 plants		30-0-53— 266 plants		30-0-57— 406 plants		30-0-58— 190 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**150**	**56**	**202**	**64**	**292**	**114**	**138**	**52**
Theoretical	154.5	51.5	199.5	66.5	304.5	101.5	142.5	47.5
Difference	**4.5**	**4.5**	**2.5**	**2.5**	**12.5**	**12.5**	**4.5**	**4.5**
Prob. Error....	4.19	4.19	4.76	4.76	5.89	5.89	4.03	4.03
	out	out	in	in	out	out	out	out
	30-0-60— 291 plants		30-0-61— 110 plants		30-0-62— 358 plants		30-0-65— 231 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**213**	**78**	**82**	**28**	**263**	**95**	**174**	**57**
Theoretical	218.3	72.8	82.5	27.5	268.5	89.5	173.3	57.8
Difference	**5.3**	**5.2**	**0.5**	**0.5**	**5.5**	**5.5**	**0.7**	**0.8**
Prob. Error....	4.98	4.98	3.06	3.06	5.53	5.53	4.44	4.44
	out	out	in	in	in	in	in	in

TABLE 52 (Continued)

	Hooded	Bearded	Hooded	Bearded	Hooded	Bearded	Hooded	Bearded
	30-0-67— 182 plants		30-0-68— 165 plants		30-0-69— 249 plants		30-0-70— 212 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**134**	**48**	**123**	**42**	**193**	**56**	**156**	**56**
Theoretical	136.5	45.5	123.8	41.3	186.8	62.3	159.0	53.0
Difference	**2.5**	**2.5**	**0.8**	**0.7**	**6.2**	**6.3**	**3.0**	**3.0**
Prob. Error....	3.94	3.94	3.75	3.75	4.61	4.61	4.25	4.25
	in	in	in	in	out	out	in	in
	30-0-73— 143 plants		30-0-74— 402 plants		30-0-75— 176 plants		30-0-76— 404 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**110**	**33**	**297**	**105**	**136**	**40**	**292**	**112**
Theoretical	107.3	35.8	301.5	100.5	132.0	44.0	303.0	101.0
Difference	**2.7**	**2.8**	**4.5**	**4.5**	**4.0**	**4.0**	**11.0**	**11.0**
Prob. Error....	3.49	3.49	5.86	5.86	3.88	3.88	5.87	5.87
	in	in	in	in	out	out	out	out
	Total of all progenies— 13928 plants							
	(3)	(1)						
Observed	**9820**	**3478**						
Theoretical	9973.5	3324.5						
Difference	**153.5**	**153.5**						
Prob. Error....	33.68	33.68						
	out	out						

PROBABLE ERROR STUDIES ON THE F_3 GENERATION OF CROSS 31 CALIFORNIA♀ × BEARDLESS♂

TABLE 53

Monohybrid Frequency Distributions Obtained in the F_3 Progenies From F_2 Hooded Parents That Were Heterozygous Hooded

	Hooded	Bearded	Hooded	Bearded	Hooded	Bearded	Hooded	Bearded
	31-0-3— 202 plants		31-0-4— 333 plants		31-0-5— 383 plants		31-0-6— 437 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**144**	**58**	**250**	**83**	**285**	**98**	**337**	**100**
Theoretical	151.5	50.5	249.8	83.3	287.3	95.8	327.8	109.3
Difference	**7.5**	**7.5**	**0.2**	**0.3**	**2.3**	**2.2**	**9.2**	**9.3**
Prob. Error....	4.15	4.15	5.33	5.33	5.72	5.72	6.11	6.11
	out	out	in	in	in	in	out	out

TABLE 53 (Continued)

	Hooded	Bearded	Hooded	Bearded	Hooded	Bearded	Hooded	Bearded
	31-0-8— 226 plants		31-0-9— 206 plants		31-0-10— 232 plants		31-0-12— 260 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**171**	**55**	**152**	**54**	**180**	**52**	**186**	**74**
Theoretical	169.5	56.5	154.5	51.5	174.0	58.0	195.0	65.0
Difference	**1.5**	**1.5**	**2.5**	**2.5**	**6.0**	**6.0**	**9.0**	**9.0**
Prob. Error....	4.39	4.39	4.19	4.19	4.45	4.45	4.71	4.71
	in	in	in	in	out	out	out	out
	31-0-13— 229 plants		31-0-14— 166 plants		31-0-15— 223 plants		31-0-18— 185 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**176**	**53**	**126**	**40**	**168**	**55**	**141**	**44**
Theoretical	171.8	57.3	124.5	41.5	167.3	55.8	138.8	46.3
Difference	**4.2**	**4.3**	**1.5**	**1.5**	**0.7**	**0.8**	**2.2**	**2.3**
Prob. Error....	4.42	4.42	3.76	3.76	4.36	4.36	3.97	3.97
	in	in	in	in	in	in	in	in
	31-0-23— 158 plants		31-0-24— 229 plants		31-0-27— 97 plants		31-0-28— 239 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**116**	**42**	**174**	**55**	**75**	**22**	**179**	**60**
Theoretical	118.5	39.5	171.8	57.3	72.8	24.3	179.3	59.8
Difference	**2.5**	**2.5**	**2.2**	**2.3**	**2.2**	**2.3**	**0.3**	**0.2**
Prob. Error....	3.67	3.67	4.42	4.42	2.88	2.88	4.52	4.52
	in	in	in	in	in	in	in	in
	31-0-29— 137 plants		31-0-31— 246 plants		31-0-32— 158 plants		31-0-33— 467 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**102**	**35**	**182**	**64**	**110**	**48**	**343**	**124**
Theoretical	102.8	34.3	184.5	61.5	118.5	39.5	350.3	116.8
Difference	**0.8**	**0.7**	**2.5**	**2.5**	**8.5**	**8.5**	**7.3**	**7.2**
Prob. Error....	3.42	3.42	4.58	4.58	3.67	3.67	6.31	6.31
	in	in	in	in	out	out	out	out
	31-0-34— 251 plants		31-0-35— 222 plants		31-0-36— 182 plants		31-0-38— 238 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**203**	**48**	**165**	**57**	**140**	**42**	**191**	**47**
Theoretical	188.3	62.8	166.5	55.5	136.5	45.5	178.5	59.5
Difference	**14.7**	**14.8**	**1.5**	**1.5**	**3.5**	**3.5**	**12.5**	**12.5**
Prob. Error....	4.63	4.63	4.35	4.35	3.94	3.94	4.51	4.51
	out	out	in	in	in	in	out	out
	31-0-41— 251 plants		31-0-42— 169 plants		31-0-43— 133 plants		31-0-44— 189 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**179**	**72**	**126**	**43**	**88**	**45**	**132**	**57**
Theoretical	188.3	62.8	126.8	42.3	99.8	33.3	141.8	47.3
Difference	**9.3**	**9.2**	**0.8**	**0.7**	**11.8**	**11.7**	**9.8**	**9.7**
Prob. Error....	4.63	4.63	3.80	3.80	3.37	3.37	4.02	4.02
	out	out	in	in	out	out	out	out

TABLE 53 (Continued)

	Hooded	Bearded	Hooded	Bearded	Hooded	Bearded	Hooded	Bearded
	31-0-45— 178 plants		31-0-48— 154 plants		31-0-50— 199 plants		31-0-51— 215 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**133**	**45**	**114**	**40**	**149**	**50**	**160**	**55**
Theoretical	133.5	44.5	115.5	38.5	149.3	49.8	161.3	53.8
Difference	**0.5**	**0.5**	**1.5**	**1.5**	**0.3**	**0.2**	**1.3**	**1.2**
Prob. Error....	3.90	3.90	3.63	3.63	4.12	4.12	4.28	4.28
	in	in	in	in	in	in	in	in
	31-0-52— 143 plants		31-0-53— 271 plants		31-0-54— 373 plants		31-0-55— 224 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**96**	**47**	**208**	**63**	**275**	**98**	**172**	**52**
Theoretical	107.3	35.8	203.3	67.8	279.8	93.3	168.0	56.0
Difference	**11.3**	**11.2**	**4.7**	**4.8**	**4.8**	**4.7**	**4.0**	**4.0**
Prob. Error....	3.49	3.49	4.81	4.81	5.64	5.64	4.37	4.37
	out	out	in	in	in	in	in	in
	31-0-56— 172 plants		31-0-58— 245 plants		31-0-59— 363 plants		31-0-60— 409 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**127**	**45**	**194**	**51**	**274**	**89**	**312**	**97**
Theoretical	129.0	43.0	183.8	61.3	272.3	90.8	306.8	102.3
Difference	**2.0**	**2.0**	**10.2**	**10.3**	**1.7**	**1.8**	**5.2**	**5.3**
Prob. Error....	3.83	3.83	4.57	4.57	5.57	5.57	5.91	5.91
	in	in	out	out	in	in	in	in
	31-0-62— 147 plants		31-0-63— 380 plants		31-0-64— 255 plants		31-0-66— 123 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**106**	**41**	**293**	**87**	**195**	**60**	**95**	**28**
Theoretical	110.3	36.8	285.0	95.0	191.3	63.8	92.3	30.8
Difference	**4.3**	**4.2**	**8.0**	**8.0**	**3.7**	**3.8**	**2.7**	**2.8**
Prob. Error....	3.54	3.54	5.69	5.69	4.66	4.66	3.24	3.24
	out	out	out	out	in	in	in	in
	31-0-67— 327 plants		31-0-69— 242 plants		31-0-71— 107 plants		31-0-72— 181 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**251**	**76**	**193**	**49**	**83**	**24**	**122**	**59**
Theoretical	245.3	81.8	181.5	60.5	80.3	26.8	135.8	45.3
Difference	**5.7**	**5.8**	**11.5**	**11.5**	**2.7**	**2.8**	**13.8**	**13.7**
Prob. Error....	5.28	5.28	4.54	4.54	3.02	3.02	3.93	3.93
	out	out	out	out	in	in	out	out
	31-0-74— 243 plants		31-0-76— 221 plants		31-0-77— 82 plants		Total of all progenies— 11702 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**193**	**50**	**159**	**62**	**57**	**25**	**8782**	**2920**
Theoretical	182.3	60.8	165.8	55.3	61.5	20.5	8776.5	2925.5
Difference	**10.7**	**10.8**	**6.8**	**6.7**	**4.5**	**4.5**	**5.5**	**5.5**
Prob. Error....	4.56	4.55	4.34	4.34	2.65	2.65	31.59	31.59
	out	out	out	out	out	out	in	in

PROBABLE ERROR STUDIES ON THE F_3 GENERATION OF CROSS 32 CALIFORNIA♀ × BLACK HULLED♂

TABLE 54

Dihybrid Freqency Distributions Obtained in the F_3 Progenies From F_2 Black Hulled, Two-row Parents That Were Heterozygous With Respect to Both Characters

	Black 2-Row	Black 6-Row	White 2-Row	White 6-Row	Black 2-Row	Black 6-Row	White 2-Row	White 6-Row	Black 2-Row	Black 6-Row	White 2-Row	White 6-Row
	32-0-1—167 plants				32-0-3—93 plants				32-0-5—127 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**87**	**33**	**34**	**13**	**47**	**23**	**17**	**6**	**72**	**26**	**22**	**7**
Theoretical	93.9	31.3	31.3	10.4	52.3	17.4	17.4	5.8	71.4	23.8	23.8	7.9
Difference	**6.9**	**1.7**	**2.7**	**2.6**	**5.3**	**5.6**	**0.4**	**0.2**	**0.6**	**2.2**	**1.8**	**0.9**
Prob. Error	4.32	3.40	3.40		3.23	2.54	2.54		3.77	2.97	2.97	
	out	in	in		out	out	in		in	in	in	
	32-0-6—68 plants				32-0-7—174 plants				32-0-9—89 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**36**	**11**	**15**	**6**	**96**	**33**	**31**	**14**	**45**	**18**	**16**	**10**
Theoretical	38.3	12.8	12.8	4.3	97.9	32.6	32.6	10.9	50.1	16.7	16.7	5.6
Difference	**2.3**	**1.8**	**2.2**	**1.7**	**1.9**	**0.4**	**1.6**	**3.1**	**5.1**	**1.3**	**0.7**	**4.4**
Prob. Error	2.76	2.17	2.17		4.41	3.47	3.47		3.16	2.48	2.48	
	in	in	out		in	in	in		out	in	in	
	32-0-14—113 plants				32-0-20—83 plants				32-0-21—59 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**64**	**14**	**26**	**9**	**50**	**18**	**11**	**4**	**30**	**9**	**14**	**6**
Theoretical	63.6	21.2	21.2	7.1	46.7	15.6	15.6	5.2	33.2	11.1	11.1	3.7
Difference	**0.4**	**7.2**	**48**	**1.9**	**3.3**	**2.4**	**4.6**	**1.2**	**3.2**	**2.1**	**2.9**	**2.3**
Prob. Error	3.56	2.80	2.80		3.05	2.40	2.40		2.57	2.02	2.02	
	in	out	out		out	in	out		out	out	out	
	32-0-22—81 plants				32-0-24—108 plants				32-0-25—135 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**48**	**8**	**17**	**8**	**59**	**24**	**17**	**8**	**82**	**28**	**21**	**4**
Theoretical	45.6	15.2	15.2	5.1	60.8	20.3	20.3	6.8	75.9	25.3	25.3	8.4
Difference	**2.4**	**7.2**	**1.8**	**2.9**	**1.8**	**3.7**	**3.3**	**1.2**	**6.1**	**2.7**	**4.3**	**4.4**
Prob. Error	3.01	2.37	2.37		3.48	2.74	2.74		3.89	3.06	3.06	
	in	out	in		in	out	out		out	in	out	
	32-0-26—99 plants				32-0-27—117 plants				32-0-32—170 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**58**	**13**	**16**	**12**	**71**	**18**	**24**	**4**	**96**	**35**	**30**	**9**
Theoretical	55.7	18.6	18.6	6.2	65.8	21.9	21.9	7.3	95.6	31.9	31.9	10.6
Difference	**2.3**	**5.6**	**2.6**	**5.8**	**5.2**	**3.9**	**2.1**	**3.3**	**0.4**	**3.1**	**1.9**	**1.6**
Prob. Error	3.33	2.62	2.62		3.62	2.85	2.85		4.36	3.43	3.43	
	in	out	in		out	out	in		in	in	in	
	32-0-36—96 plants				32-0-37—79 plants				32-0-43—213 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**58**	**18**	**17**	**3**	**41**	**12**	**21**	**5**	**132**	**37**	**32**	**12**
Theoretical	54.0	18.0	18.0	6.0	44.4	14.8	14.8	4.9	119.8	39.9	39.9	13.3
Difference	**4.0**	**0.0**	**1.0**	**3.0**	**3.4**	**2.8**	**6.2**	**0.1**	**12.2**	**2.9**	**7.9**	**1.3**
Prob. Error	3.28	2.58	2.58		2.97	2.34	2.34		4.88	3.84	3.84	
	out	in	in		out	out	out		out	in	out	

TABLE 54 (Continued)

	Black 2-Row	Black 6-Row	White 2-Row	White 6-Row	Black 2-Row	Black 6-Row	White 2-Row	White 6-Row	Black 2-Row	Black 6-Row	White 2-Row	White 6-Row
	32-0-45—175 plants				32-0-46—114 plants				32-0-48—146 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**103**	**28**	**36**	**8**	**66**	**21**	**21**	**6**	**84**	**22**	**32**	**8**
Theoretical	98.4	32.8	32.8	10.9	64.1	21.4	21.4	7.1	82.1	27.4	27.4	9.1
Difference	**4.6**	**4.8**	**3.2**	**2.9**	**1.9**	**0.4**	**0.4**	**1.1**	**1.9**	**5.4**	**4.6**	**1.1**
Prob. Error	4.43	3.48	3.48		3.57	2.81	2.81		4.04	3.18	3.18	
	out	out	in		in	in	in		in	out	out	
	32-0-51—91 plants				Total of all progenies 2597 plants							
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)				
Observed	**55**	**11**	**19**	**6**	**1480**	**460**	**489**	**168**				
Theoretical	51.2	17.1	17.1	5.7	1460.8	486.9	486.9	162.3				
Difference	**3.8**	**6.1**	**1.9**	**0.3**	**19.2**	**26.9**	**2.1**	**5.7**				
Prob. Error	3.19	2.51	2.51		17.05	13.42	13.42					
	out	out	in		out	out	in					

TABLE 55

Monohybrid Frequency Distributions Obtained in the F_3 Progenies from F_2 Black Hulled, Two-row Parents That Were Heterozygous Two-row and Homozygous Black Hulled

	Black 2-row	Black 6-row	Black 2-row	Black 6-row	Black 2-row	Black 6-row	Black 2-row	Black 6-row	Black 2-row	Black 6-row
	32-0-10—133 plants		32-0-12—131 plants		32-0-17—40 plants		32-0-29—45 plants		32-0-30—118 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**94**	**39**	**87**	**44**	**29**	**11**	**33**	**12**	**93**	**25**
Theoretical ...	99.8	33.3	98.3	32.8	30.0	10.0	33.8	11.3	88.5	29.5
Difference	**5.8**	**5.7**	**11.3**	**11.2**	**1.0**	**1.0**	**0.8**	**0.7**	**4.5**	**4.5**
Prob. Error...	3.37	3.37	3.34	3.34	1.85	1.85	1.96	1.96	3.17	3.17
	out	out	out	out	in	in	in	in	out	out
	32-0-33—113 plants		32-0-35—181 plants		32-0-38—67 plants		32-0-39—66 plants		32-0-40—95 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**86**	**27**	**143**	**38**	**52**	**15**	**49**	**17**	**68**	**27**
Theoretical ...	84.8	28.3	135.8	45.3	50.3	16.8	49.5	16.5	71.3	23.8
Difference	**1.2**	**1.3**	**7.2**	**7.3**	**1.7**	**1.8**	**0.5**	**0.5**	**3.3**	**3.2**
Prob. Error...	3.11	3.11	3.93	3.93	2.39	2.39	2.37	2.37	2.85	2.85
	in	in	out	out	in	in	in	in	out	out
	32-0-44—174 plants		Total of all progenies—1163 plants							
	(3)	(1)	(3)	(1)						
Observed	**124**	**50**	**858**	**305**						
Theoretical ...	130.5	43.5	872.3	290.8						
Difference	**6.5**	**6.5**	**14.3**	**14.2**						
Prob. Error...	3.85	3.85	9.96	9.96						
	out	out	out	out						

TABLE 56

Monohybrid Frequency Distributions Obtained in the F_3 Progenies From F_2 Black Hulled, Two-row Parents That Were Heterozygous Black Hulled and Homozygous Two-row

	Black 2-row	White 2-row	Black 2-row	White 2-row	Black 2-row	White 2-row	Black 2-row	White 2-row	Black 2-row	White 2-row
	32-0-8— 113 plants		32-0-13— 127 plants		32-0-16— 164 plants		32-0-18— 147 plants		32-0-19— 46 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**87**	**26**	**93**	**34**	**122**	**42**	**114**	**33**	**32**	**14**
Theoretical ...	84.8	28.3	95.3	31.8	123.0	41.0	110.3	36.8	34.5	11.5
Difference	**2.2**	**2.3**	**2.3**	**2.2**	**1.0**	**1.0**	**3.7**	**3.8**	**2.5**	**2.5**
Prob. Error...	3.11	3.11	3.29	3.29	3.74	3.74	3.54	3.54	1.98	1.98
	in	in	in	in	in	in	out	out	out	out
	32-0-23— 183 plants		32-0-28— 73 plants		32-0-31— 154 plants		32-0-34— 203 plants		32-0-41— 70 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**152**	**31**	**54**	**19**	**120**	**34**	**149**	**54**	**58**	**12**
Theoretical ...	137.3	45.8	54.8	18.3	115.5	38.5	152.3	50.8	52.5	17.5
Difference	**14.7**	**14.8**	**0.8**	**0.7**	**4.5**	**4.5**	**3.3**	**3.2**	**5.5**	**5.5**
Prob. Error...	3.95	3.95	2.50	2.50	3.63	3.63	4.16	4.16	2.44	2.44
	out	out	in	in	out	out	in	in	out	out
	32-0-42— 104 plants		32-0-47— 196 plants		32-0-49— 100 plants		32-0-52— 133 plants		Total of all progenies 1813 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**80**	**24**	**144**	**52**	**71**	**29**	**97**	**36**	**1373**	**440**
Theoretical ...	78.0	26.0	147.0	49.0	75.0	25.0	99.8	33.3	1359.75	453.25
Difference	**2.0**	**2.0**	**3.0**	**3.0**	**4.0**	**4.0**	**2.8**	**2.7**	**13.25**	**13.25**
Prob. Error...	2.98	2.98	4.09	4.09	2.92	2.92	3.37	3.37	12.44	12.44
	in	in	in	in	out	out	in	in	out	out

TABLE 57

Monohybrid Frequency Distributions Obtained in the F_3 Progenies From F_2 Black Hulled, Six-row Parents That Were Heterozygous Black Hulled

	Black 6-row	White 6-row	Black 6-row	White 6-row	Black 6-row	White 6-row	Black 6-row	White 6-row	Black 6-row	White 6-row
	32-0-54— 169 plants		32-0-55— 131 plants		32-0-57— 212 plants		32-0-58— 242 plants		32-0-59— 233 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**125**	**44**	**94**	**37**	**163**	**49**	**168**	**74**	**164**	**69**
Theoretical ...	126.8	42.3	98.3	32.8	159.0	53.0	181.5	60.5	174.8	58.3
Difference	**1.8**	**1.7**	**4.3**	**4.2**	**4.0**	**4.0**	**13.5**	**13.5**	**10.8**	**10.7**
Prob. Error...	3.80	3.80	3.34	3.34	4.25	4.25	4.54	4.54	4.46	4.46
	in	in	out	out	in	in	out	out	out	out
	32-0-60— 165 plants		32-0-63— 203 plants		32-0-65— 240 plants		32-0-66— 166 plants		32-0-67— 249 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**114**	**51**	**147**	**56**	**176**	**64**	**132**	**34**	**184**	**65**
Theoretical ...	123.8	41.3	152.3	50.8	180.0	60.0	124.5	41.5	186.8	62.3
Difference	**9.8**	**9.7**	**5.3**	**5.2**	**4.0**	**4.0**	**7.5**	**7.5**	**2.8**	**2.7**
Prob. Error...	3.75	3.75	4.16	4.16	4.52	4.52	3.76	3.76	4.61	4.61
	out	out	out	out	in	in	out	out	in	in

TABLE 57 (Continued)

	Black 6-row	White 6-row	Black 6-row	White 6-row	Black 6-row	White 6-row	Black 6-row	White 6-row	Black 6-row	White 6-row
	32-0-70— 121 plants		32-0-71— 251 plants		32-0-72— 158 plants		Total of all progenies 2540 plants			
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)		
Observed	**95**	**26**	**196**	**55**	**118**	**40**	**1876**	**664**		
Theoretical ...	90.8	30.3	188.3	62.8	118.5	39.5	1905.0	635.0		
Difference	**4.2**	**4.3**	**7.7**	**7.8**	**0.5**	**0.5**	**29.0**	**29.0**		
Prob. Error...	3.21	3.21	4.63	4.63	3.67	3.67	14.72	14.72		
	out	out	out	out	in	in	out	out		

TABLE 58

Monohybrid Frequency Distributions Obtained in the F_3 Progenies From F_2 White Hulled, Two-row Parents That Were Heterozygous Two-row

	White 2-row	White 6-row	White 2-row	White 6-row	White 2-row	White 6-row	White 2-row	White 6-row	White 2-row	White 6-row
	32-0-74— 68 plants		32-0-75— 96 plants		32-0-76— 126 plants		32-0-77— 92 plants		32-0-78— 104 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**50**	**18**	**70**	**26**	**97**	**29**	**63**	**29**	**80**	**24**
Theoretical ...	51.0	17.0	72.0	24.0	94.5	31.5	69.0	23.0	78.0	26.0
Difference	**1.0**	**1.0**	**2.0**	**2.0**	**2.5**	**2.5**	**6.0**	**6.0**	**2.0**	**2.0**
Prob. Error...	2.41	2.41	2.86	2.86	3.28	3.28	2.80	2.80	2.98	2.98
	in	in	in	in	in	in	out	out	in	in
	32-0-79— 91 plants		32-0-80— 130 plants		32-0-82— 124 plants		32-0-83— 68 plants		32-0-84— 73 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**70**	**21**	**105**	**25**	**88**	**36**	**43**	**25**	**56**	**17**
Theoretical ...	68.3	22.8	97.5	32.5	93.0	31.0	51.0	17.0	54.8	18.3
Difference	**1.7**	**1.8**	**7.5**	**7.5**	**5.0**	**5.0**	**8.0**	**8.0**	**1.2**	**1.3**
Prob. Error...	2.79	2.79	3.33	3.33	3.25	3.25	2.41	2.41	2.50	2.50
	in	in	out	out	out	out	out	out	in	in
	32-0-85— 74 plants		32-0-87— 69 plants		32-0-89— 55 plants		32-0-91— 34 plants		32-0-94— 159 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**51**	**23**	**51**	**18**	**43**	**12**	**28**	**6**	**115**	**44**
Theoretical ...	55.5	18.5	51.8	17.3	41.3	13.8	25.5	8.5	119.3	39.8
Difference	**4.5**	**4.5**	**0.8**	**0.7**	**1.7**	**1.8**	**2.5**	**2.5**	**4.3**	**4.2**
Prob. Error...	2.51	2.51	2.43	2.43	2.17	2.17	1.70	1.70	3.68	3.68
	out	out	in	in	in	in	out	out	out	out
	Total of all progenies— 1363 plants									
	(3)	(1)								
Observed	**1010**	**353**								
Theoretical ..	1022.3	340.8								
Difference ...	**12.3**	**12.2**								
Prob. Error..	10.78	10.78								
	out	out								

PROBABLE ERROR STUDIES ON THE F_3 GENERATION OF CROSS 36 BLACK HULLED♀ × BEARDLESS♂

TABLE 59

Trihybrid Frequency Distributions Obtained in the F_3 Progenies From F_2 Hooded, Black Hulled, Two-rowed Parents That Were Heterozygous With Respect to All Three Characters

	Black Hooded 2-row	Black Bearded 2-row	Black Hooded 6-row	White Hooded 2-row	Black Bearded 6-row	White Bearded 2-row	White Hooded 6-row	White Bearded 6-row
				36-0-1—78 plants				
	(27)	(9)	(9)	(9)	(3)	(3)	(3)	(1)
Observed	**32**	**14**	**8**	**16**	**2**	**4**	**2**	**0**
Theoretical	32.9	11.0	11.0	11.0	3.7	3.7	3.7	1.2
Difference	**0.9**	**3.0**	**3.0**	**5.0**	**1.7**	**0.3**	**1.7**	**1.2**
Prob. Error......	2.94	2.07	2.07	2.07	1.26	1.26	1.26	
	in	out	out	out	out	in	out	
				36-0-2—70 plants				
	(27)	(9)	(9)	(9)	(3)	(3)	(3)	(1)
Observed	**31**	**6**	**13**	**15**	**3**	**0**	**1**	**1**
Theoretical	29.5	9.8	9.8	9.8	3.3	3.3	3.3	1.1
Difference	**1.5**	**3.8**	**3.2**	**5.2**	**0.3**	**3.3**	**2.3**	**0.1**
Prob. Error......	2.79	1.96	1.96	1.96	1.19	1.19	1.19	
	in	out	out	out	in	out	out	
				36-0-6—102 plants				
	(27)	(9)	(9)	(9)	(3)	(3)	(3)	(1)
Observed	**49**	**17**	**12**	**10**	**5**	**4**	**4**	**1**
Theoretical	43.0	14.3	14.3	14.3	4.8	4.8	4.8	1.6
Difference	**6.0**	**2.7**	**2.3**	**4.3**	**0.2**	**0.8**	**0.8**	**0.6**
Prob. Error......	3.37	2.37	2.37	2.37	1.44	1.44	1.44	
	out	out	in	out	out	in	in	
				36-0-8—90 plants				
	(27)	(9)	(9)	(9)	(3)	(3)	(3)	(1)
Observed	**33**	**9**	**16**	**10**	**4**	**8**	**9**	**1**
Theoretical	38.0	12.7	12.7	12.7	4.2	4.2	4.2	1.4
Difference	**5.0**	**3.7**	**3.3**	**2.7**	**0.2**	**3.8**	**4.8**	**0.4**
Prob. Error......	3.16	2.23	2.23	2.23	1.35	1.35	1.35	
	out	out	out	out	in	out	out	
				36-0-10—76 plants				
	(27)	(9)	(9)	(9)	(3)	(3)	(3)	(1)
Observed	**36**	**9**	**12**	**7**	**4**	**5**	**2**	**1**
Theoretical	32.1	10.7	10.7	10.7	3.6	3.6	3.6	1.2
Difference	**3.9**	**1.7**	**1.3**	**3.7**	**0.4**	**1.4**	**1.6**	**0.2**
Prob. Error......	2.90	2.04	2.04	2.04	1.24	1.24	1.24	
	out	in	in	out	in	out	out	
				36-0-20—73 plants				
	(27)	(9)	(9)	(9)	(3)	(3)	(3)	(1)
Observed	**36**	**11**	**9**	**6**	**3**	**1**	**5**	**2**
Theoretical	30.8	10.3	10.3	10.3	3.4	3.4	3.4	1.1
Difference	**5.2**	**0.7**	**1.3**	**4.3**	**0.4**	**2.4**	**1.6**	**0.9**
Prob. Error......	2.85	2.00	2.00	2.00	1.22	1.22	1.22	
	out	in	in	out	in	out	out	

TABLE 59 (Continued)

	Black Hood-ed 2-row	Black Beard-ed 2-row	Black Hood-ed 6-row	White Hood-ed 2-row	Black Beard-ed 6-row	White Beard-ed 2-row	White Hood-ed 6-row	White Beard-ed 6-row
				36-0-21—116 plants				
	(27)	(9)	(9)	(9)	(3)	(3)	(3)	(1)
Observed	**49**	**21**	**17**	**12**	**1**	**8**	**8**	**0**
Theoretical	48.9	16.3	16.3	16.3	5.4	5.4	5.4	1.8
Difference	**0.1**	**4.7**	**0.7**	**4.3**	**4.4**	**2.6**	**2.6**	**1.8**
Prob. Error......	3.59	2.53	2.53	2.53	1.54	1.54	1.54	
	in	out	in	out	out	out	out	
				36-0-24—176 plants				
	(27)	(9)	(9)	(9)	(3)	(3)	(3)	(1)
Observed	**67**	**39**	**22**	**25**	**7**	**6**	**9**	**1**
Theoretical	74.3	24.8	24.8	24.8	8.3	8.3	8.3	2.8
Difference	**7.3**	**14.2**	**2.8**	**0.2**	**1.3**	**2.3**	**0.7**	**1.8**
Prob. Error......	4.42	3.11	3.11	3.11	1.89	1.89	1.89	
	out	out	in	in	in	out	in	
				36-0-40—83 plants				
	(27)	(9)	(9)	(9)	(3)	(3)	(3)	(1)
Observed	**37**	**5**	**12**	**10**	**4**	**6**	**6**	**3**
Theoretical	35.0	11.7	11.7	11.7	3.9	3.9	3.9	1.3
Difference	**2.0**	**6.7**	**0.3**	**1.7**	**0.1**	**2.1**	**2.1**	**1.7**
Prob. Error......	3.04	2.14	2.14	2.14	1.30	1.30	1.30	
	in	out	in	in	in	out	out	
				36-0-41—67 plants				
	(27)	(9)	(9)	(9)	(3)	(3)	(3)	(1)
Observed	**31**	**8**	**7**	**11**	**2**	**1**	**5**	**2**
Theoretical	28.3	9.4	9.4	9.4	3.1	3.1	3.1	1.0
Difference	**2.7**	**1.4**	**2.4**	**1.6**	**1.1**	**2.1**	**1.9**	**1.0**
Prob. Error......	2.73	1.92	1.92	1.92	1.17	1.17	1.17	
	in	in	out	in	in	out	out	
				36-0-55—76 plants				
	(27)	(9)	(9)	(9)	(3)	(3)	(3)	(1)
Observed	**36**	**13**	**8**	**10**	**1**	**6**	**2**	**0**
Theoretical	32.1	10.7	10.7	10.7	3.6	3.6	3.6	1.2
Difference	**3.9**	**2.3**	**2.7**	**0.7**	**2.6**	**2.4**	**1.6**	**1.2**
Prob. Error......	2.90	2.04	2.04	2.04	1.24	1.24	1.24	
	out	out	out	in	out	out	out	
				36-0-57—99 plants				
	(27)	(9)	(9)	(9)	(3)	(3)	(3)	(1)
Observed	**50**	**15**	**7**	**13**	**7**	**3**	**2**	**2**
Theoretical	41.8	13.9	13.9	13.9	4.6	4.6	4.6	1.5
Difference	**8.2**	**1.1**	**6.9**	**0.9**	**2.4**	**1.6**	**2.6**	**0.5**
Prob. Error......	3.32	2.33	2.33	2.33	1.42	1.42	1.42	
	out	in	out	in	out	out	out	

TABLE 59 (Continued)

	Black Hooded 2-row	Black Bearded 2-row	Black Hooded 6-row	White Hooded 2-row	Black Bearded 6-row	White Bearded 2-row	White Hooded 6-row	White Bearded 6-row
				36-0-60—84 plants				
	(27)	(9)	(9)	(9)	(3)	(3)	(3)	(1)
Observed	**33**	**11**	**12**	**13**	**4**	**4**	**4**	**3**
Theoretical	35.4	11.8	11.8	11.8	3.9	3.9	3.9	1.3
Difference	**2.4**	**0.8**	**0.2**	**1.2**	**0.1**	**0.1**	**0.1**	**1.7**
Prob. Error......	3.05	2.15	2.15	2.15	1.31	1.31	1.31	
	in	in	in	in	in	in	in	
				36-0-66—105 plants				
	(27)	(9)	(9)	(9)	(3)	(3)	(3)	(1)
Observed	**46**	**17**	**11**	**18**	**3**	**7**	**2**	**1**
Theoretical	44.3	14.8	14.8	14.8	4.9	4.9	4.9	1.6
Difference	**1.7**	**2.2**	**3.8**	**3.2**	**1.9**	**2.1**	**2.9**	**0.6**
Prob. Error......	3.41	2.40	2.40	2.40	1.46	1.46	1.46	
	in	in	out	out	out	out	out	
				36-0-70—65 plants				
	(27)	(9)	(9)	(9)	(3)	(3)	(3)	(1)
Observed	**23**	**8**	**9**	**15**	**3**	**2**	**2**	**3**
Theoretical	27.4	9.1	9.1	9.1	3.0	3.0	3.0	1.0
Difference	**4.4**	**1.1**	**0.1**	**5.9**	**0.0**	**1.0**	**1.0**	**2.0**
Prob. Error......	2.69	1.89	1.89	1.89	1.15	1.15	1.15	
	out	in	in	out	in	in	in	
				36-0-76—65 plants				
	(27)	(9)	(9)	(9)	(3)	(3)	(3)	(1)
Observed	**29**	**4**	**7**	**11**	**6**	**4**	**1**	**3**
Theoretical	27.4	9.1	9.1	9.1	3.0	3.0	3.0	1.0
Difference	**1.6**	**5.1**	**2.1**	**1.9**	**3.0**	**1.0**	**2.0**	**2.0**
Prob. Error......	2.69	1.89	1.89	1.89	1.15	1.15	1.15	
	in	out	out	out	out	in	out	
				36-0-78—78 plants				
	(27)	(9)	(9)	(9)	(3)	(3)	(3)	(1)
Observed	**40**	**9**	**9**	**12**	**2**	**1**	**4**	**1**
Theoretical	32.9	11.0	11.0	11.0	3.7	3.7	3.7	1.2
Difference	**7.1**	**2.0**	**2.0**	**1.0**	**1.7**	**2.7**	**0.3**	**0.2**
Prob. Error......	2.94	2.07	2.07	2.07	1.26	1.26	1.26	
	out	in	in	in	out	out	in	
				36-0-87—80 plants				
	(27)	(9)	(9)	(9)	(3)	(3)	(3)	(1)
Observed	**41**	**6**	**9**	**10**	**4**	**5**	**3**	**2**
Theoretical	33.8	11.3	11.3	11.3	3.8	3.8	3.8	1.3
Difference	**7.2**	**5.3**	**2.3**	**1.3**	**0.2**	**1.2**	**0.8**	**0.7**
Prob. Error......	2.98	2.10	2.10	2.10	1.28	1.28	1.28	
	out	out	out	in	in	in	in	

TABLE 59 (Continued)

	Black Hooded 2-row	Black Bearded 2-row	Black Hooded 6-row	White Hooded 2-row	Black Bearded 6-row	White Bearded 2-row	White Hooded 6-row	White Bearded 6-row
				36-0-90—138 plants				
	(27)	(9)	(9)	(9)	(3)	(3)	(3)	(1)
Observed	**53**	**21**	**21**	**23**	**6**	**9**	**5**	**0**
Theoretical	58.2	19.4	19.4	19.4	6.5	6.5	6.5	2.2
Difference	**5.2**	**1.6**	**1.6**	**3.6**	**0.5**	**2.5**	**1.5**	**2.2**
Prob. Error	3.91	2.76	2.76	2.76	1.68	1.68	1.68	
	out	in	in	out	in	out	in	
				36-0-93—116 plants				
	(27)	(9)	(9)	(9)	(3)	(3)	(3)	(1)
Observed	**43**	**22**	**19**	**21**	**3**	**4**	**4**	**0**
Theoretical	48.9	16.3	16.3	16.3	5.4	5.4	5.4	1.8
Difference	**5.9**	**5.7**	**2.7**	**4.7**	**2.4**	**1.4**	**1.4**	**1.8**
Prob. Error	3.59	2.53	2.53	2.53	1.54	1.54	1.54	
	out	out	out	out	out	in	in	
				36-0-95—99 plants				
	(27)	(9)	(9)	(9)	(3)	(3)	(3)	(1)
Observed	**42**	**19**	**14**	**9**	**3**	**6**	**2**	**4**
Theoretical	41.8	13.9	13.9	13.9	4.6	4.6	4.6	1.5
Difference	**0.2**	**5.1**	**0.1**	**4.9**	**1.6**	**1.4**	**2.6**	**2.5**
Prob. Error	3.32	2.33	2.33	2.33	1.42	1.42	1.42	
	in	out	in	out	out	in	out	
				36-0-102—66 plants				
	(27)	(9)	(9)	(9)	(3)	(3)	(3)	(1)
Observed	**31**	**9**	**10**	**7**	**4**	**3**	**2**	**0**
Theoretical	27.8	9.3	9.3	9.3	3.1	3.1	3.1	1.0
Difference	**3.2**	**0.3**	**0.7**	**2.3**	**0.9**	**0.1**	**1.1**	**1.0**
Prob. Error	2.71	1.91	1.91	1.91	1.16	1.16	1.16	
	out	in	in	out	in	in	in	
				36-0-104—191 plants				
	(27)	(9)	(9)	(9)	(3)	(3)	(3)	(1)
Observed	**79**	**29**	**21**	**28**	**10**	**10**	**11**	**3**
Theoretical	80.6	26.9	26.9	26.9	9.0	9.0	9.0	3.0
Difference	**1.6**	**2.1**	**5.9**	**1.1**	**1.0**	**1.0**	**2.0**	**0.0**
Prob. Error	4.60	3.24	3.24	3.24	1.97	1.97	1.97	
	in	in	out	in	in	in	out	
				36-0-111—137 plants				
	(27)	(9)	(9)	(9)	(3)	(3)	(3)	(1)
Observed	**54**	**15**	**21**	**27**	**4**	**6**	**4**	**6**
Theoretical	57.8	19.3	19.3	19.3	6.4	6.4	6.4	2.1
Difference	**3.8**	**4.3**	**1.7**	**7.7**	**2.4**	**0.4**	**2.4**	**3.9**
Prob. Error	3.90	2.75	2.75	2.75	1.67	1.67	1.67	
	in	out	in	out	out	in	out	

TABLE 59 (Continued)

	Black Hooded 2-row	Black Bearded 2-row	Black Hooded 6-row	White Hooded 2-row	Black Beadred 6-row	White Bearded 2-row	White Hooded 6-row	White Bearded 6-row
	36-0-118—70 plants							
	(27)	(9)	(9)	(9)	(3)	(3)	(3)	(1)
Observed	**36**	**4**	**11**	**11**	**2**	**2**	**1**	**3**
Theoretical	29.5	9.8	9.8	9.8	3.3	3.3	3.3	1.1
Difference	**6.5**	**5.8**	**1.2**	**1.2**	**1.3**	**1.3**	**2.3**	**1.9**
Prob. Error	2.79 out	1.96 out	1.96 in	1.96 in	1.19 out	1.19 out	1.19 out	
	36-0-123—106 plants							
	(27)	(9)	(9)	(9)	(3)	(3)	(3)	(1)
Observed	**48**	**19**	**12**	**11**	**8**	**3**	**3**	**2**
Theoretical	44.7	14.9	14.9	14.9	5.0	5.0	5.0	1.7
Difference	**3.3**	**4.1**	**2.9**	**3.9**	**3.0**	**2.0**	**2.0**	**0.3**
Prob. Error	3.43 in	2.41 out	2.41 out	2.41 out	1.47 out	1.47 out	1.47 out	
	36-0-126—90 plants							
	(27)	(9)	(9)	(9)	(3)	(3)	(3)	(1)
Observed	**32**	**9**	**21**	**9**	**7**	**5**	**6**	**1**
Theoretical	38.0	12.7	12.7	12.7	4.2	4.2	4.2	1.4
Difference	**6.0**	**3.7**	**8.3**	**3.7**	**2.8**	**0.8**	**1.8**	**0.4**
Prob. Error	3.16 out	2.23 out	2.23 out	2.23 out	1.35 out	1.35 in	1.35 out	
	Total of all progenies including 18 of less than 64 population—3477 plants							
	(27)	(9)	(9)	(9)	(3)	(3)	(3)	(1)
Observed	**1498**	**507**	**470**	**474**	**151**	**160**	**156**	**61**
Theoretical	1466.9	489.0	489.0	489.0	163.0	163.0	163.0	54.3
Difference	**31.1**	**18.0**	**19.0**	**15.0**	**12.0**	**3.0**	**7.0**	**6.7**
Prob. Error	19.64 out	13.83 out	13.83 out	13.83 out	8.41 out	8.41 in	8.41 in	

TABLE 60

Dihybrid Frequency Distributions Obtained in the F_3 Progenies From F_2 Hooded, Black Hulled, Two-row Parents That Were Heterozygous With Respect to Hoods and Two-row and Homozygous Black Hulled

	Black Hooded 2-row	Black Bearded 2-row	Black Hooded 6-row	Black Bearded 6-row	Black Hooded 2-row	Black Bearded 2-row	Black Hooded 6-row	Black Bearded 6-row
	36-0-3—33 plants				36-0-13—48 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**17**	**7**	**8**	**1**	**29**	**5**	**9**	**5**
Theoretical	18.6	6.2	6.2	2.1	27.0	9.0	9.0	3.0
Difference	**1.6**	**0.8**	**1.8**	**1.1**	**2.0**	**4.0**	**0.0**	**2.0**
Prob. Error	1.92 in	1.51 in	1.51 out		2.32 in	1.82 out	1.82 in	

TABLE 60 (Continued)

	Black Hooded 2-row	Black Bearded 2-row	Black Hooded 6-row	Black Bearded 6-row	Black Hooded 2-row	Black Bearded 2-row	Black Hooded 6-row	Black Bearded 6-row
	36-0-16—42 plants				36-0-36—21 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**19**	**9**	**7**	**7**	**14**	**1**	**5**	**1**
Theoretical ...	23.6	7.9	7.9	2.6	11.8	3.9	3.9	1.3
Difference	**4.6**	**1.1**	**0.9**	**4.4**	**2.2**	**2.9**	**1.1**	**0.3**
Prob. Error....	2.17	1.71	1.71		1.53	1.21	1.21	
	out	in	in		out	out	in	
	36-0-47—30 plants				36-0-59—130 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**19**	**6**	**3**	**2**	**75**	**19**	**28**	**8**
Theoretical ...	16.9	5.6	5.6	1.9	73.1	24.4	24.4	8.1
Difference	**2.1**	**0.4**	**2.6**	**0.1**	**1.9**	**5.4**	**3.6**	**0.1**
Prob. Error....	1.83	1.44	1.44		3.82	3.00	3.00	
	out	in	out		in	out	out	
	36-0-68—55 plants				36-0-74—67 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**24**	**12**	**12**	**7**	**36**	**11**	**13**	**7**
Theoretical ...	30.9	10.3	10.3	3.4	37.7	12.6	12.6	4.2
Difference	**6.9**	**1.7**	**1.7**	**3.6**	**1.7**	**1.6**	**0.4**	**2.8**
Prob. Error....	2.48	1.95	1.95		2.74	2.16	2.16	
	out	in	in		in	in	in	
	36-0-89—103 plants				36-0-91—20 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**67**	**13**	**13**	**10**	**12**	**4**	**3**	**1**
Theoretical ...	57.9	19.3	19.3	6.4	11.3	3.8	3.8	1.3
Difference	**9.1**	**6.3**	**6.3**	**3.6**	**0.7**	**0.2**	**0.8**	**0.3**
Prob. Error....	3.40	2.67	2.67		1.50	1.18	1.18	
	out	out	out		in	out	in	
	36-0-97—58 plants				36-0-112—123 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**40**	**8**	**7**	**3**	**75**	**23**	**20**	**5**
Theoretical ...	32.6	10.9	10.9	3.6	69.2	23.1	23.1	7.7
Difference	**7.4**	**2.9**	**3.9**	**0.6**	**5.8**	**0.1**	**3.1**	**2.7**
Prob. Error....	2.55	2.01	2.01		3.71	2.92	2.92	
	out	out	out		out	in	out	
	36-0-115—39 plants				36-0-119—101 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**15**	**9**	**12**	**3**	**52**	**26**	**19**	**4**
Theoretical ...	21.9	7.3	7.3	2.4	56.8	18.9	18.9	6.3
Difference	**6.9**	**1.7**	**4.7**	**0.6**	**4.8**	**7.1**	**0.1**	**2.3**
Prob. Error....	2.09	1.64	1.64		3.36	2.65	2.65	
	out	out	out		out	out	in	

TABLE 60 (Continued)

	Black Hooded 2-row	Black Bearded 2-row	Black Hooded 6-row	Black Bearded 6-row	Black Hooded 2-row	Black Bearded 2-row	Black Hooded 6-row	Black Bearded 6-row
	36-0-127—34 plants				Total of all progenies including 5 of less than 16 population—961 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**22**	**4**	**6**	**2**	**548**	**170**	**174**	**69**
Theoretical ...	19.1	6.4	6.4	2.1	540.6	180.2	180.2	60.1
Difference	**2.9**	**2.4**	**0.4**	**0.1**	**7.4**	**10.2**	**6.2**	**8.9**
Prob. Error....	1.95	1.54	1.54		10.37	8.16	8.16	
	out	out	in		in	out	in	

TABLE 61

Dihybrid Frequency Distributions Obtained in the F_3 Progenies From F_2 Hooded, Black Hulled, Two-row Parents That Were Heterozygous With Respect to Black Hulled and Two-row and Homozygous Hooded

	Black Hooded 2-row	Black Hooded 6-row	White Hooded 2-row	White Hooded 6-row	Black Hooded 2-row	Black Hooded 6-row	White Hooded 2-row	White Hooded 6-row
	36-0-4—84 plants				36-0-17—53 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**51**	**14**	**13**	**6**	**34**	**9**	**8**	**2**
Theoretical ...	47.3	15.8	15.8	5.3	29.8	9.9	9.9	3.3
Difference	**3.7**	**1.8**	**2.8**	**0.7**	**4.2**	**0.9**	**1.9**	**1.3**
Prob. Error....	3.07	2.41	2.41		2.44	1.92	1.92	
	out	in	out		out	in	in	
	36-0-42—41 plants				36-0-45—16 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**19**	**9**	**10**	**3**	**10**	**2**	**2**	**2**
Theoretical ...	23.1	7.7	7.7	2.6	9.0	3.0	3.0	1.0
Difference	**4.1**	**1.3**	**2.3**	**0.4**	**1.0**	**1.0**	**1.0**	**1.0**
Prob. Error....	2.14	1.69	1.69		1.34	1.05	1.05	
	out	in	out		in	in	in	
	36-0-51—44 plants				36-0-62—84 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**21**	**12**	**8**	**3**	**48**	**13**	**17**	**6**
Theoretical ...	24.8	8.3	8.3	2.8	47.3	15.8	15.8	5.3
Difference	**3.8**	**3.7**	**0.3**	**0.2**	**0.7**	**2.8**	**1.2**	**0.7**
Prob. Error....	2.22	1.75	1.75		3.07	2.41	2.41	
	out	out	in		in	out	in	
	36-0-63—30 plants				36-0-64—48 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**23**	**4**	**3**	**0**	**26**	**9**	**7**	**6**
Theoretical ...	16.9	5.6	5.6	1.9	27.0	9.0	9.0	3.0
Difference	**6.1**	**1.6**	**2.6**	**1.9**	**1.0**	**0.0**	**2.0**	**3.0**
Prob. Error....	1.83	1.44	1.44		2.32	1.82	1.82	
	out	out	out		in	in	out	

TABLE 61 (Continued)

	Black Hooded 2-row	Black Hooded 6-row	White Hooded 2-row	White Hooded 6-row	Black Hooded 2-row	Black Hooded 6-row	White Hooded 2-row	White Hooded 6-row
	36-0-83—58 plants				36-0-85—40 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**35**	**10**	**8**	**5**	**27**	**4**	**8**	**1**
Theoretical ...	32.6	10.9	10.9	3.6	22.5	7.5	7.5	2.5
Difference	**2.4**	**0.9**	**2.9**	**1.4**	**4.5**	**3.5**	**0.5**	**1.5**
Prob. Error....	2.55	2.01	2.01		2.12	1.67	1.67	
	in	in	out		out	out	in	
	36-0-86—78 plants				36-0-100—108 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**41**	**20**	**12**	**5**	**53**	**19**	**28**	**8**
Theoretical ...	43.9	14.6	14.6	4.9	60.8	20.3	20.3	6.8
Difference	**2.9**	**5.4**	**2.6**	**0.1**	**7.8**	**1.3**	**7.7**	**1.2**
Prob. Error....	2.96	2.33	2.33		3.48	2.74	2.74	
	in	out	out		out	in	out	
	36-0-101—65 plants				Total of all progenies including 1 with less than 16 population—762 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**35**	**18**	**8**	**4**	**429**	**146**	**134**	**53**
Theoretical ...	36.6	12.2	12.2	4.1	428.6	142.9	142.9	47.6
Difference	**1.6**	**5.8**	**4.2**	**0.1**	**0.4**	**3.1**	**8.9**	**5.4**
Prob. Error....	2.70	2.12	2.12		9.24	7.27	7.27	
	in	out	out		in	in	out	

TABLE 62

Dihybrid Frequency Distributions Obtained in the F_3 Progenies From F_2 Hooded, Black Hulled, Two-row Parents That Were Heterozygous With Respect to Black Hulled and Hoods and Homozygous Two-row

	Black Hooded 2-row	Black Bearded 2-row	White Hooded 2-row	White Bearded 2-row	Black Hooded 2-row	Black Bearded 2-row	White Hooded 2-row	White Bearded 2-row
	36-0-5—79 plants				36-0-7—101 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**48**	**15**	**11**	**5**	**52**	**30**	**14**	**5**
Theoretical ...	44.4	14.8	14.8	4.9	56.8	18.9	18.9	6.3
Difference	**3.6**	**0.2**	**3.8**	**0.1**	**4.8**	**11.1**	**4.9**	**1.3**
Prob. Error....	2.97	2.34	2.34		3.36	2.65	2.65	
	out	in	out		out	out	out	
	36-0-25—23 plants				36-0-37—56 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**14**	**5**	**3**	**1**	**32**	**9**	**11**	**4**
Theoretical ...	12.9	4.3	4.3	1.4	31.5	10.5	10.5	3.5
Difference	**1.1**	**0.7**	**1.3**	**0.4**	**0.5**	**1.5**	**0.5**	**0.5**
Prob. Error....	1.61	1.26	1.26		2.50	1.97	1.97	
	in	in	out		in	in	in	

TABLE 62 (Continued)

	Black Hooded 2-row	Black Bearded 2-row	White Hooded 2-row	White Bearded 2-row	Black Hooded 2-row	Black Bearded 2-row	White Hooded 2-row	White Bearded 2-row
	36-0-50—39 plants				36-0-53—105 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**21**	**10**	**6**	**2**	**67**	**22**	**9**	**7**
Theoretical ...	21.9	7.3	7.3	2.4	59.1	19.7	19.7	6.6
Difference	**0.9**	**2.7**	**1.3**	**0.4**	**7.9**	**2.3**	**10.7**	**0.4**
Prob. Error....	2.09	1.64	1.64		3.43	2.70	2.70	
	in	out	in		out	in	out	
	36-0-79—34 plants				36-0-92—32 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**19**	**8**	**4**	**3**	**20**	**5**	**7**	**0**
Theoretical ...	19.1	6.4	6.4	2.1	18.0	6.0	6.0	2.0
Difference	**0.1**	**1.6**	**2.4**	**0.9**	**2.0**	**1.0**	**1.0**	**2.0**
Prob. Error....	1.95	1.54	1.54		1.89	1.49	1.49	
	in	out	out		out	in	in	
	36-0-96—87 plants				36-0-120—26 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**52**	**14**	**19**	**2**	**16**	**5**	**5**	**0**
Theoretical ...	48.9	16.3	16.3	5.4	14.6	4.9	4.9	1.6
Difference	**3.1**	**2.3**	**2.7**	**3.4**	**1.4**	**0.1**	**0.1**	**1.6**
Prob. Error....	3.12	2.46	2.46		1.71	1.34	1.34	
	in	in	out		in	in	in	
	Total of all progenies including 3 of less than 16 population—614 plants							
	(9)	(3)	(3)	(1)				
Observed	**357**	**127**	**99**	**31**				
Theoretical ...	345.4	115.1	115.1	38.4				
Difference	**11.6**	**11.9**	**16.1**	**7.4**				
Prob. Error....	8.29	6.52	6.52					
	out	out	out					

TABLE 63

Monohybrid Frequency Distributions Obtained in the F_3 Progenies From F_2 Hooded, Black Hulled, Two-row Parents That Were Heterozygous Two-row and Homozygous With Respect to Black Hulled and Hooded

	Black Hooded 2-row	Black Hooded 6-row	Black Hooded 2-row	Black Hooded 6-row	Black Hooded 2-row	Black Hooded 6-row	Black Hooded 2-row	Black Hooded 6-row
	36-0-11—47 plants		36-0-22—70 plants		36-0-38—96 plants		36-0-67—48 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**35**	**12**	**53**	**17**	**79**	**17**	**36**	**12**
Theoretical ...	35.3	11.8	52.5	17.5	72.0	24.0	36.0	12.0
Difference	**0.3**	**0.2**	**0.5**	**0.5**	**7.0**	**7.0**	**0.0**	**0.0**
Prob. Error....	2.00	2.00	2.44	2.44	2.86	2.86	2.02	2.02
	in	in	in	in	out	out	in	in

TABLE 63 (Continued)

	Black Hooded 2-row	Black Hooded 6-row	Black Hooded 2-row	Black Hooded 6-row	Black Hooded 2-row	Black Hooded 6-row	Black Hooded 2-row	Black Hooded 6-row
	36-0-77— 63 plants		36-0-103— 41 plants		Total of all progenies— 365 plants			
	(3)	(1)	(3)	(1)	(3)	(1)		
Observed	**53**	**10**	**33**	**8**	**289**	**76**		
Theoretical	47.3	15.8	30.8	10.3	273.8	91.3		
Difference	**5.7**	**5.8**	**2.2**	**2.3**	**15.2**	**15.3**		
Prob. Error....	2.32	2.32	1.87	1.87	5.58	5.58		
	out	out	out	out	out	out		

TABLE 64

Monohybrid Frequency Distributions Obtained in the F_3 Progenies From F_2 Hooded, Black Hulled, Two-row Parents That Were Heterozygous Hooded and Homozygous With Respect to Black Hulled and Two-row

	Black Hooded 2-row	Black Bearded 2-row	Black Hooded 2-row	Black Bearded 2-row	Black Hooded 2-row	Black Bearded 2-row	Black Hooded 2-row	Black Bearded 2-row
	36-0-15— 89 plants		36-0-27— 35 plants		36-0-44— 9 plants		36-0-73— 38 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**61**	**28**	**25**	**10**	**4**	**5**	**27**	**11**
Theoretical	66.8	22.3	26.3	8.8	6.8	2.3	28.5	9.5
Difference	**5.8**	**5.7**	**1.3**	**1.2**	**2.8**	**2.7**	**1.5**	**1.5**
Prob. Error....	2.76	2.76	1.73	1.73	0.88	0.88	1.80	1.80
	out	out	in	in	out	out	in	in
	36-0-75— 89 plants		36-0-107— 13 plants		36-0-108— 83 plants		36-0-113— 77 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**61**	**28**	**11**	**2**	**64**	**19**	**58**	**19**
Theoretical	66.8	22.3	9.8	3.3	62.3	20.8	57.8	19.3
Difference	**5.8**	**5.7**	**1.2**	**1.3**	**1.7**	**1.8**	**0.2**	**0.3**
Prob. Error....	2.76	2.76	1.05	1.05	2.66	2.66	2.56	2.56
	out	out	out	out	in	in	in	in
	Total of all progenies— 433 plants							
	(3)	(1)						
Observed	**311**	**122**						
Theoretical	324.8	108.3						
Difference	**13.8**	**13.7**						
Prob. Error....	6.08	6.08						
	out	out						

TABLE 65

Monohybrid Frequency Distributions Obtained in the F_3 Progenies From F_2 Hooded, Black Hulled, Two-row Parents That Were Heterozygous Black Hulled and Homozygous With Respect to Hooded and Two-row

	Black Hooded 2-row	White Hooded 2-row	Black Hooded 2-row	White Hooded 2-row	Black Hooded 2-row	White Hooded 2-row	Black Hooded 2-row	White Hooded 2-row
	36-0-19—33 plants		36-0-32—63 plants		36-0-49—4 plants		36-0-52—32 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**26**	**7**	**45**	**18**	**3**	**1**	**22**	**10**
Theoretical	24.8	8.3	47.3	15.8	3.0	1.0	24.0	8.0
Difference	**1.2**	**1.3**	**2.3**	**2.2**	**0.0**	**0.0**	**2.0**	**2.0**
Prob. Error....	1.68	1.68	2.32	2.32	0.58	0.58	1.65	1.65
	in	in	in	in	in	in	out	out
	36-0-58—41 plants		36-0-69—101 plants		36-0-72—60 plants		36-0-80—15 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**32**	**9**	**73**	**28**	**45**	**15**	**11**	**4**
Theoretical	30.8	10.3	75.8	25.3	45.0	15.0	11.3	3.8
Difference	**1.2**	**1.3**	**2.8**	**2.7**	**0.0**	**0.0**	**0.3**	**0.2**
Prob. Error....	1.87	1.87	2.94	2.94	2.26	2.26	1.13	1.13
	in	in	in	in	in	in	in	in
	36-0-82—71 plants		36-0-106—35 plants		36-0-122—52 plants		Total of all progenies—507 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**53**	**18**	**26**	**9**	**40**	**12**	**376**	**131**
Theoretical	53.3	17.8	26.3	8.8	39.0	13.0	380.3	126.8
Difference	**0.3**	**0.2**	**0.3**	**0.2**	**1.0**	**1.0**	**4.3**	**4.2**
Prob. Error....	2.46	2.46	1.73	1.73	2.11	2.11	6.58	6.58
	in	in	in	in	in	in	in	in

TABLE 66

Dihybrid Frequency Distributions Obtained in the F_3 Progenies From F_2 Hooded, Black Hulled, Six-row Parents That Were Heterozygous With Respect to Hooded and Black Hulled

	Black Hooded 6-row	Black Bearded 6-row	White Hooded 6-row	White Bearded 6-row	Black Hooded 6-row	Black Bearded 6-row	White Hooded 6-row	White Bearded 6-row
	36-0-136—98 plants				36-0-137—76 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**62**	**19**	**10**	**7**	**46**	**17**	**11**	**2**
Theoretical ...	55.1	18.4	18.4	6.1	42.8	14.3	14.3	4.8
Difference	**6.9**	**0.6**	**8.4**	**0.9**	**3.2**	**2.7**	**3.3**	**2.8**
Prob. Error....	3.31	2.61	2.61		2.92	2.30	2.30	
	out	in	out		out	out	out	

TABLE 66 (Continued)

	Black Hooded 6-row	Black Bearded 6-row	White Hooded 6-row	White Bearded 6-row	Black Hooded 6-row	Black Bearded 6-row	White Hooded 6-row	White Bearded 6-row
	36-0-139—138 plants				36-0-144—23 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**75**	**27**	**28**	**8**	**12**	**6**	**5**	**0**
Theoretical ...	77.6	25.9	25.9	8.6	12.9	4.3	4.3	1.4
Difference	**2.6**	**1.1**	**2.1**	**0.6**	**0.9**	**1.7**	**0.7**	**1.4**
Prob. Error....	3.93	3.09	3.09		1.61	1.26	1.26	
	in	in	in		in	out	in	
	36-0-145—158 plants				36-0-146—155 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**81**	**34**	**30**	**13**	**85**	**32**	**26**	**12**
Theoretical ...	88.9	29.6	29.6	9.9	87.2	29.1	29.1	9.7
Difference	**7.9**	**4.4**	**0.4**	**3.1**	**2.2**	**2.9**	**3.1**	**2.3**
Prob. Error....	4.21	3.31	3.31		4.17	3.28	3.28	
	out	out	in		in	in	in	
	36-0-148—115 plants				36-0-150—216 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**56**	**32**	**22**	**5**	**117**	**49**	**37**	**13**
Theoretical ...	64.7	21.6	21.6	7.2	121.5	40.5	40.5	13.5
Difference	**8.7**	**10.4**	**0.4**	**2.2**	**4.5**	**8.5**	**3.5**	**0.5**
Prob. Error....	3.59	2.82	2.82		4.92	3.87	3.87	
	out	out	in		in	out	in	
	36-0-152—54 plants				36-0-157—171 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**31**	**8**	**11**	**4**	**100**	**35**	**28**	**8**
Theoretical ...	30.4	10.1	10.1	3.4	96.2	32.1	32.1	10.7
Difference	**0.6**	**2.1**	**0.9**	**0.6**	**3.8**	**2.9**	**4.1**	**2.7**
Prob. Error....	2.46	1.93	1.93		4.38	3.44	3.44	
	in	out	in		in	in	out	
	36-0-164—136 plants				36-0-165—251 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**85**	**25**	**17**	**9**	**144**	**52**	**37**	**18**
Theoretical ...	76.5	25.5	25.5	8.5	141.2	47.1	47.1	15.7
Difference	**8.5**	**0.5**	**8.5**	**0.5**	**2.8**	**4.9**	**10.1**	**2.3**
Prob. Error....	3.90	3.07	3.07		5.30	4.17	4.17	
	out	in	out		in	out	out	
	36-0-166—76 plants				36-0-167—100 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**47**	**11**	**12**	**6**	**53**	**25**	**15**	**7**
Theoretical ...	42.8	14.3	14.3	4.8	56.3	18.8	18.8	6.3
Difference	**4.2**	**3.3**	**2.3**	**1.2**	**3.3**	**6.2**	**3.8**	**0.7**
Prob. Error....	2.92	2.30	2.30		3.35	2.63	2.63	
	out	out	in		in	out	out	
	36-0-173—61 plants				36-0-175—71 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**35**	**14**	**10**	**2**	**46**	**21**	**3**	**1**
Theoretical ...	34.3	11.4	11.4	3.8	39.9	13.3	13.3	4.4
Difference	**0.7**	**2.6**	**1.4**	**1.8**	**6.1**	**7.7**	**10.3**	**3.4**
Prob. Error....	2.61	2.06	2.06		2.82	2.22	2.22	
	in	out	in		out	out	out	

TABLE 66 (Continued)

	Black Hooded 6-row	Black Bearded 6-row	White Hooded 6-row	White Bearded 6-row	Black Hooded 6-row	Black Bearded 6-row	White Hooded 6-row	White Bearded 6-row
	36-0-176—224 plants				Total of all progenies including 1 of less than 16 population—2132 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**113**	**46**	**50**	**15**	**1194**	**455**	**352**	**131**
Theoretical ...	126.0	42.0	42.0	14.0	1199.3	399.8	399.8	133.3
Difference	**13.0**	**4.0**	**8.0**	**1.0**	**5.3**	**55.2**	**47.8**	**2.3**
Prob. Error....	5.01 out	3.94 out	3.94 out		15.45 in	12.16 out	12.16 out	

TABLE 67

Monohybrid Frequency Distributions Obtained in the F_3 Progenies From F_2 Hooded, Black Hulled, Six-row Parents That Were Heterozygous Hooded and Homozygous Black Hulled

	Black Hooded 6-row	Black Bearded 6-row	Black Hooded 6-row	Black Bearded 6-row	Black Hooded 6-row	Black Bearded 6-row	Black Hooded 6-row	Black Bearded 6-row
	36-0-130—236 plants		36-0-132—165 plants		36-0-133—24 plants		36-0-138—20 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**169**	**67**	**129**	**36**	**18**	**6**	**17**	**3**
Theoretical	177.0	59.0	123.8	41.3	18.0	6.0	15.0	5.0
Difference	**8.0**	**8.0**	**5.2**	**5.3**	**0.0**	**0.0**	**2.0**	**2.0**
Prob. Error....	4.49 out	4.49 out	3.75 out	3.75 out	1.43 in	1.43 in	1.31 out	1.31 out
	36-0-140—66 plants		36-0-149—181 plants		36-0-153—133 plants		36-0-155—58 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**53**	**13**	**130**	**51**	**105**	**28**	**43**	**15**
Theoretical	49.5	16.5	135.8	45.3	99.8	33.3	43.5	14.5
Difference	**3.5**	**3.5**	**5.8**	**5.7**	**5.2**	**5.3**	**0.5**	**0.5**
Prob. Error....	2.37 out	2.37 out	3.93 out	3.93 out	3.37 out	3.37 out	2.22 in	2.22 in
	36-0-161—149 plants		36-0-168—49 plants		36-0-171—165 plants		36-0-174—34 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**104**	**45**	**38**	**11**	**122**	**43**	**25**	**9**
Theoretical	111.8	37.3	36.8	12.3	123.8	41.3	25.5	8.5
Difference	**7.8**	**7.7**	**1.2**	**1.3**	**1.8**	**1.7**	**0.5**	**0.5**
Prob. Error....	3.57 out	3.57 out	2.04 in	2.04 in	3.75 in	3.75 in	1.70 in	1.70 in
	36-0-179—170 plants		Total of all progenies—1450 plants					
	(3)	(1)	(3)	(1)				
Observed	**127**	**43**	**1080**	**370**				
Theoretical	127.5	42.5	1087.5	362.5				
Difference	**0.5**	**0.5**	**7.5**	**7.5**				
Prob. Error....	3.81 in	3.81 in	11.12 in	11.12 in				

TABLE 68

Monohybrid Frequency Distributions Obtained in the F_3 Progenies From F_2 Hooded, Black Hulled, Six-row Parents That Were Heterozygous Black Hulled and Homozygous Hooded

	Black Hooded 6-row	White Hooded 6-row	Black Hooded 6-row	White Hooded 6-row	Black Hooded 6-row	White Hooded 6-row	Black Hooded 6-row	White Hooded 6-row
	36-0-129—85 plants		36-0-135—162 plants		36-0-141—187 plants		36-0-147—45 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**71**	**14**	**124**	**38**	**131**	**56**	**40**	**5**
Theoretical	63.8	21.3	121.5	40.5	140.3	46.8	33.8	11.3
Difference	**7.2**	**7.3**	**2.5**	**2.5**	**9.3**	**9.2**	**6.2**	**6.3**
Prob. Error....	2.69 out	2.69 out	3.72 in	3.72 in	3.99 out	3.99 out	1.96 out	1.96 out
	36-0-154—28 plants		36-0-156—170 plants		36-0-158—153 plants		36-0-159—39 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**17**	**11**	**123**	**47**	**131**	**22**	**31**	**8**
Theoretical	21.0	7.0	127.5	42.5	114.8	38.3	29.3	9.8
Difference	**4.0**	**4.0**	**4.5**	**4.5**	**16.2**	**16.3**	**1.7**	**1.8**
Prob. Error....	1.55 out	1.55 out	3.81 out	3.81 out	3.61 out	3.61 out	1.82 in	1.82 in
	36-0-160—88 plants		36-0-177—92 plants		36-0-178—67 plants		36-0-180—23 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**66**	**22**	**71**	**21**	**56**	**11**	**17**	**6**
Theoretical	66.0	22.0	69.0	23.0	50.3	16.8	17.3	5.8
Difference	**0.0**	**0.0**	**2.0**	**2.0**	**5.7**	**5.8**	**0.3**	**0.2**
Prob. Error....	2.74 in	2.74 in	2.80 in	2.80 in	2.39 out	2.39 out	1.40 in	1.40 in
	Total of all progenies—1139 plants							
	(3)	(1)						
Observed	**878**	**261**						
Theoretical	854.3	284.8						
Difference	**23.7**	**23.8**						
Prob. Error....	9.86 out	9.86 out						

TABLE 69

Dihybrid Frequency Distributions Obtained in the F_3 Progenies From F_2 Hooded, White Hulled, Two-row Parents That Were Heterozygous With Respect to Hooded and Two-row

	White Hooded 2-row	White Bearded 2-row	White Hooded 6-row	White Bearded 6-row	White Hooded 2-row	White Bearded 2-row	White Hooded 6-row	White Bearded 6-row
	36-0-181—33 plants				36-0-184—104 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**14**	**9**	**7**	**3**	**61**	**18**	**19**	**6**
Theoretical ...	18.6	6.2	6.2	2.1	58.5	19.5	19.5	6.5
Difference	**4.6**	**2.8**	**0.8**	**0.9**	**2.5**	**1.5**	**0.5**	**0.5**
Prob. Error....	1.92	1.51	1.51		3.41	2.69	2.69	
	out	out	in		in	in	in	
	36-0-186—44 plants				36-0-187—63 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**20**	**16**	**4**	**4**	**33**	**12**	**11**	**7**
Theoretical ...	24.8	8.3	8.3	2.8	35.4	11.8	11.8	3.9
Difference	**4.8**	**7.7**	**4.3**	**1.2**	**2.4**	**0.2**	**0.8**	**3.1**
Prob. Error....	2.22	1.75	1.75		2.66	2.09	2.09	
	out	out	out		in	in	in	
	36-0-189—24 plants				36-0-192—48 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**8**	**7**	**6**	**3**	**22**	**15**	**9**	**2**
Theoretical ...	13.5	4.5	4.5	1.5	27.0	9.0	9.0	3.0
Difference	**5.5**	**2.5**	**1.5**	**1.5**	**5.0**	**6.0**	**0.0**	**1.0**
Prob. Error....	1.64	1.29	1.29		2.32	1.82	1.82	
	out	out	out		out	out	in	
	36-0-194—90 plants				36-0-197—60 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**46**	**23**	**15**	**6**	**35**	**9**	**13**	**3**
Theoretical ...	50.6	16.9	16.9	5.6	33.8	11.3	11.3	3.8
Difference	**4.6**	**6.1**	**1.9**	**0.4**	**1.2**	**2.3**	**1.7**	**0.8**
Prob. Error....	3.17	2.50	2.50		2.59	2.04	2.04	
	out	out	in		in	out	in	
	36-0-199—58 plants				36-0-203—43 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**31**	**7**	**14**	**6**	**19**	**13**	**5**	**6**
Theoretical ...	32.6	10.9	10.9	3.6	24.2	8.1	8.1	2.7
Difference	**1.6**	**3.9**	**3.1**	**2.4**	**5.2**	**4.9**	**3.1**	**3.3**
Prob. Error....	2.55	2.01	2.01		2.19	1.73	1.73	
	in	out	out		out	out	out	
	36-0-206—35 plants				36-0-210—35 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**18**	**10**	**5**	**2**	**18**	**3**	**10**	**4**
Theoretical ...	19.7	6.6	6.6	2.2	19.7	6.6	6.6	2.2
Difference	**1.7**	**3.4**	**1.6**	**0.2**	**1.7**	**3.6**	**3.4**	**1.8**
Prob. Error....	1.98	1.56	1.56		1.98	1.56	1.56	
	in	out	out		in	out	out	

TABLE 69 (Continued)

	White Hooded 2-row	White Bearded 2-row	White Hooded 6-row	White Bearded 6-row	White Hooded 2-row	White Bearded 2-row	White Hooded 6-row	White Bearded 6-row
	36-0-212—56 plants				36-0-213—95 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**37**	**4**	**13**	**2**	**48**	**19**	**22**	**6**
Theoretical	31.5	10.5	10.5	3.5	53.4	17.8	17.8	5.9
Difference	**5.5**	**6.5**	**2.5**	**1.5**	**5.4**	**1.2**	**4.2**	**0.1**
Prob. Error	2.50	1.97	1.97		3.26	2.57	2.57	
	out	out	out		out	in	out	
	36-0-217—111 plants				36-0-219—40 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**69**	**18**	**19**	**5**	**29**	**5**	**6**	**0**
Theoretical	62.4	20.8	20.8	6.9	22.5	7.5	7.5	2.5
Difference	**6.6**	**2.8**	**1.8**	**1.9**	**6.5**	**2.5**	**1.5**	**2.5**
Prob. Error	3.53	2.77	2.77		2.12	1.67	1.67	
	out	out	in		out	out	in	
	36-0-220—38 plants				Total of all progenies including 3 of less than 16 population—1010 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**17**	**9**	**10**	**2**	**537**	**209**	**196**	**68**
Theoretical	21.4	7.1	7.1	2.4	568.1	189.4	189.4	63.1
Difference	**4.4**	**1.9**	**2.9**	**0.4**	**31.1**	**19.6**	**6.6**	**4.9**
Prob. Error	2.06	1.62	1.62		10.63	8.37	8.37	
	out	out	out		out	out	in	

TABLE 70

Monohybrid Frequency Distributions Obtained in the F_3 Progenies From F_2 Hooded, White Hulled, Two-row Parents That Were Heterozygous Two-row and Homozygous Hooded

	White Hooded 2-row	White Hooded 6-row	White Hooded 2-row	White Hooded 6-row	White Hooded 2-row	White Hooded 6-row	White Hooded 2-row	White Hooded 6-row
	36-0-182—49 plants		36-0-183—139 plants		36-0-185—12 plants		36-0-195—5 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**36**	**13**	**107**	**32**	**9**	**3**	**4**	**1**
Theoretical	36.8	12.3	104.3	34.8	9.0	3.0	3.8	1.3
Difference	**0.8**	**0.7**	**2.7**	**2.8**	**0.0**	**0.0**	**0.2**	**0.3**
Prob. Error	2.04	2.04	3.44	3.44	1.01	1.01	0.65	0.65
	in	in	in	in	in	in	in	in
	36-0-201—15 plants		36-0-202—93 plants		36-0-205—22 plants		36-0-214—108 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**12**	**3**	**69**	**24**	**16**	**6**	**85**	**23**
Theoretical	11.3	3.8	69.8	23.3	16.5	5.5	81.0	27.0
Difference	**0.7**	**0.8**	**0.8**	**0.7**	**0.5**	**0.5**	**4.0**	**4.0**
Prob. Error	1.13	1.13	2.82	2.82	1.37	1.37	3.04	3.04
	in	in	in	in	in	in	out	out

TABLE 70 (Continued)

	White Hooded 2-row	White Hooded 6-row	White Hooded 2-row	White Hooded 6-row	White Hooded 2-row	White Hooded 6-row	White Hooded 2-row	White Hooded 6-row
	36-0-216— 15 plants		Total of all progenies— 458 plants					
	(3)	(1)	(3)	(1)				
Observed	**10**	**5**	**348**	**110**				
Theoretical	11.3	3.8	343.5	114.5				
Difference	**1.3**	**1.2**	**4.5**	**4.5**				
Prob. Error	1.13 out	1.13 out	6.25 in	6.25 in				

TABLE 71

Monohybrid Frequency Distributions Obtained in the F_3 Progenies From F_2 Hooded, White Hulled, Two-row Parents That Were Heterozygous Hooded and Homozygous Two-row

	White Hooded 2-row	White Bearded 2-row	White Hooded 2-row	White Bearded 2-row	White Hooded 2-row	White Bearded 2-row	White Hooded 2-row	White Bearded 2-row
	36-0-196— 41 plants		36-0-198— 26 plants		36-0-200— 30 plants		36-0-208— 28 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**32**	**9**	**20**	**6**	**25**	**5**	**22**	**6**
Theoretical	30.8	10.3	19.5	6.5	22.5	7.5	21.0	7.0
Difference	**1.2**	**1.3**	**0.5**	**0.5**	**2.5**	**2.5**	**1.0**	**1.0**
Prob. Error	1.87 in	1.87 in	1.49 in	1.49 in	1.60 out	1.60 out	1.55 in	1.55 in
	Total of all progenies— 125 plants							
	(3)	(1)						
Observed	**99**	**26**						
Theoretical	93.8	31.3						
Difference	**5.2**	**5.3**						
Prob. Error	3.27 out	3.27 out						

TABLE 72

Monohybrid Frequency Distributions Obtained in the F_3 Progenies From F_2 Hooded, White Hulled, Six-row Parents That Were Heterozygous Hooded

	White Hooded 6-row	White Bearded 6-row	White Hooded 6-row	White Bearded 6-row	White Hooded 6-row	White Bearded 6-row	White Hooded 6-row	White Bearded 6-row
	36-0-221—116 plants		36-0-222—108 plants		36-0-224—122 plants		36-0-225—43 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**83**	**33**	**78**	**30**	**94**	**28**	**31**	**12**
Theoretical	87.0	29.0	81.0	27.0	91.5	30.5	32.3	10.8
Difference	**4.0**	**4.0**	**3.0**	**3.0**	**2.5**	**2.5**	**1.3**	**1.2**
Prob. Error....	3.15	3.15	3.04	3.04	3.23	3.23	1.92	1.92
	out	out	in	in	in	in	in	in
	36-0-226—127 plants		36-0-230—123 plants		36-0-232—32 plants		36-0-234—62 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**102**	**25**	**89**	**34**	**22**	**10**	**37**	**25**
Theoretical	95.3	31.8	92.3	30.8	24.0	8.0	46.5	15.5
Difference	**6.7**	**6.8**	**3.3**	**3.2**	**2.0**	**2.0**	**9.5**	**9.5**
Prob. Error....	3.29	3.29	3.24	3.24	1.65	1.65	2.30	2.30
	out	out	out	out	out	out	out	out
	36-0-235—9 plants		Total of all progenies—742 plants					
	(3)	(1)	(3)	(1)				
Observed	**4**	**5**	**540**	**202**				
Theoretical	6.8	2.3	556.5	185.5				
Difference	**2.8**	**2.7**	**16.5**	**16.5**				
Prob. Error....	0.88	0.88	7.96	7.96				
	out	out	out	out				

TABLE 73

Dihybrid Frequency Distributions Obtained in the F_3 Progenies From F_2 Bearded, Black Hulled, Two-row Parents That Were Heterozygous With Respect to Black Hulled and Two-row

	Black Bearded 2-row	Black Bearded 6-row	White Bearded 2-row	White Bearded 6-row	Black Bearded 2-row	Black Bearded 6-row	White Bearded 2-row	White Bearded 6-row
	36-0-236—107 plants				36-0-237—61 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**48**	**27**	**26**	**6**	**36**	**10**	**8**	**7**
Theoretical ...	60.2	20.1	20.1	6.7	34.3	11.4	11.4	3.8
Difference	**12.2**	**6.9**	**5.9**	**0.7**	**1.7**	**1.4**	**3.4**	**3.2**
Prob. Error....	3.46	2.72	2.72		2.61	2.06	2.06	
	out	out	out		in	in	out	

TABLE 73 (Continued)

	Black Bearded 2-row	Black Bearded 6-row	White Bearded 2-row	White Bearded 6-row	Black Bearded 2-row	Black Bearded 6-row	White Bearded 2-row	White Bearded 6-row
	36-0-241—88 plants				36-0-244—138 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**46**	**18**	**20**	**4**	**79**	**29**	**21**	**9**
Theoretical ...	49.5	16.5	16.5	5.5	77.6	25.9	25.9	8.6
Difference	**3.5**	**1.5**	**3.5**	**1.5**	**1.4**	**3.1**	**4.9**	**0.4**
Prob. Error....	3.14	2.47	2.47		3.93	3.09	3.09	
	out	in	out		in	out	out	
	36-0-246—23 plants				36-0-247—19 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**15**	**5**	**3**	**0**	**7**	**6**	**5**	**1**
Theoretical ...	12.9	4.3	4.3	1.4	10.7	3.6	3.6	1.2
Difference	**2.1**	**0.7**	**1.3**	**1.4**	**3.7**	**2.4**	**1.4**	**0.2**
Prob. Error....	1.61	1.26	1.26		1.46	1.15	1.15	
	out	in	out		out	out	out	
	36-0-248—93 plants				36-0-253—20 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**47**	**20**	**21**	**5**	**15**	**3**	**2**	**0**
Theoretical ...	52.3	17.4	17.4	5.8	11.3	3.8	3.8	1.3
Difference	**5.3**	**2.6**	**3.6**	**0.8**	**3.7**	**0.8**	**1.8**	**1.3**
Prob. Error....	3.23	2.54	2.54		1.50	1.18	1.18	
	out	out	out		out	in	out	
	36-0-256—18 plants				36-0-257—167 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**8**	**4**	**5**	**1**	**99**	**28**	**29**	**11**
Theoretical ...	10.1	3.4	3.4	1.1	93.9	31.3	31.3	10.4
Difference	**2.1**	**0.6**	**1.6**	**0.1**	**5.1**	**3.3**	**2.3**	**0.6**
Prob. Error....	1.42	1.12	1.12		4.32	3.40	3.40	
	out	in	out		out	in	in	
	36-0-258—83 plants				36-0-260—106 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**51**	**17**	**12**	**3**	**52**	**24**	**26**	**4**
Theoretical ...	46.7	15.6	15.6	5.2	59.6	19.9	19.9	6.6
Difference	**4.3**	**1.4**	**3.6**	**2.2**	**7.6**	**4.1**	**6.1**	**2.6**
Prob. Error....	3.05	2.40	2.40		3.45	2.71	2.71	
	out	in	out		out	out	out	
	36-0-261—147 plants				36-0-263—55 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**71**	**33**	**34**	**9**	**30**	**9**	**11**	**5**
Theoretical ...	82.7	27.6	27.6	9.2	30.9	10.3	10.3	3.4
Difference	**11.7**	**5.4**	**6.4**	**0.2**	**0.9**	**1.3**	**0.7**	**1.6**
Prob. Error....	4.06	3.19	3.19		2.48	1.95	1.95	
	out	out	out		in	in	in	

TABLE 73 (Continued)

	Black Bearded 2-row	Black Bearded 6-row	White Bearded 2-row	White Bearded 6-row	Black Bearded 2-row	Black Bearded 6-row	White Bearded 2-row	White Bearded 6-row
	36-0-264—52 plants				36-0-270—48 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**27**	**8**	**11**	**6**	**32**	**7**	**8**	**1**
Theoretical ...	29.3	9.8	9.8	3.3	27.0	9.0	9.0	3.0
Difference	**2.3**	**1.8**	**1.2**	**2.7**	**5.0**	**2.0**	**1.0**	**2.0**
Prob. Error....	2.41	1.90	1.90		2.32	1.82	1.82	
	in	in	in		out	out	in	
	36-0-271—116 plants				36-0-273—62 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**64**	**23**	**19**	**10**	**40**	**9**	**10**	**3**
Theoretical ...	65.3	21.8	21.8	7.3	34.9	11.6	11.6	3.9
Difference	**1.3**	**1.2**	**2.8**	**2.7**	**5.1**	**2.6**	**1.6**	**0.9**
Prob. Error....	3.60	2.84	2.84		2.64	2.07	2.07	
	in	in	in		out	out	in	
	36-0-275—79 plants				36-0-277—59 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**43**	**20**	**13**	**3**	**36**	**8**	**9**	**6**
Theoretical ...	44.4	14.8	14.8	4.9	33.2	11.1	11.1	3.7
Difference	**1.4**	**5.2**	**1.8**	**1.9**	**2.8**	**3.1**	**2.1**	**2.3**
Prob. Error....	2.97	2.34	2.34		2.57	2.02	2.02	
	in	out	in		out	out	out	
	36-0-281—66 plants				Total of all progenies—1607 plants			
	(9)	(3)	(3)	(1)	(9)	(3)	(3)	(1)
Observed	**35**	**9**	**19**	**3**	**881**	**317**	**312**	**97**
Theoretical ...	37.1	12.4	12.4	4.1	903.9	301.3	301.3	100.4
Difference	**2.1**	**3.4**	**6.6**	**1.1**	**22.9**	**15.7**	**10.7**	**3.4**
Prob. Error....	2.72	2.14	2.14		13.41	10.55	10.55	
	in	out	out		out	out	out	

TABLE 74

Monohybrid Frequency Distributions Obtained in the F_3 Progenies From F_2 Bearded, Black Hulled, Two-row Parents That Were Heterozygous Two-row and Homozygous Black Hulled

	Black Bearded 2-row	Black Bearded 6-row	Black Bearded 2-row	Black Bearded 6-row	Black Bearded 2-row	Black Bearded 6-row	Black Bearded 2-row	Black Bearded 6-row
	36-0-238—52 plants		36-0-239—27 plants		36-0-240—122 plants		36-0-242—42 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**40**	**12**	**23**	**4**	**91**	**31**	**35**	**7**
Theoretical	39.0	13.0	20.3	6.8	91.5	30.5	31.5	10.5
Difference	**1.0**	**1.0**	**2.7**	**2.8**	**0.5**	**0.5**	**3.5**	**3.5**
Prob. Error....	2.11	2.11	1.52	1.52	3.23	3.23	1.89	1.89
	in	in	out	out	in	in	out	out

TABLE 74 (Continued)

	Black Bearded 2-row	Black Bearded 6-row	Black Bearded 2-row	Black Bearded 6-row	Black Bearded 2-row	Black Bearded 6-row	Black Bearded 2-row	Black Bearded 6-row
	36-0-245— 14 plants		36-0-252— 16 plants		36-0-255— 88 plants		36-0-259— 60 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**11**	**3**	**10**	**6**	**63**	**25**	**47**	**13**
Theoretical	10.5	3.5	12.0	4.0	66.0	22.0	45.0	15.0
Difference	**0.5**	**0.5**	**2.0**	**2.0**	**3.0**	**3.0**	**2.0**	**2.0**
Prob. Error....	1.09	1.09	1.17	1.17	2.74	2.74	2.26	2.26
	in	in	out	out	out	out	in	in
	36-0-267— 11 plants		36-0-268— 27 plants		36-0-269— 8 plants		36-0-272— 115 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**8**	**3**	**20**	**7**	**4**	**4**	**91**	**24**
Theoretical	8.3	2.8	20.3	6.8	6.0	2.0	86.3	28.8
Difference	**0.3**	**0.2**	**0.3**	**0.2**	**2.0**	**2.0**	**4.7**	**4.8**
Prob. Error....	0.97	0.97	1.52	1.52	0.83	0.83	3.13	3.13
	in	in	in	in	out	out	out	out
	36-0-278— 132 plants		36-0-279— 39 plants		36-0-280— 83 plants		Total of all progenies— 836 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**104**	**28**	**30**	**9**	**68**	**15**	**645**	**191**
Theoretical	99.0	33.0	29.3	9.8	62.3	20.8	627.0	209.0
Difference	**5.0**	**5.0**	**0.7**	**0.8**	**5.7**	**5.8**	**18.0**	**18.0**
Prob. Error....	3.36	3.36	1.82	1.82	2.66	2.66	8.44	8.44
	out	out	in	in	out	out	out	out

TABLE 75

Monohybrid Frequency Distributions Obtained in the F_3 Progenies From F_2 Bearded, Black Hulled, Two-row Parents That Were Heterozygous Black Hulled and Homozygous Two-row

	Black Bearded 2-row	White Bearded 2-row	Black Bearded 2-row	White Bearded 2-row	Black Bearded 2-row	White Bearded 2-row	Black Bearded 2-row	White Bearded 2-row
	36-0-243— 31 plants		36-0-249— 117 plants		36-0-251— 33 plants		36-0-276— 142 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**29**	**2**	**81**	**36**	**23**	**10**	**110**	**32**
Theoretical	23.3	7.8	87.8	29.3	24 8	8.3	106.5	35.5
Difference	**5.7**	**5.8**	**6.8**	**6.7**	**1.8**	**1.7**	**3.5**	**3.5**
Prob. Error....	1.63	1.63	3.16	3.16	1.68	1.68	3.48	3.48
	out	out	out	out	out	out	out	out

TABLE 75 (Continued)

	Black Bearded 2-row	White Bearded 2-row	Black Bearded 2-row	White Bearded 2-row	Black Bearded 2-row	White Bearded 2-row	Black Bearded 2-row	White Bearded 2-row
	Total of all progenies— 323 plants							
	(3)	(1)						
Observed	**243**	**80**						
Theoretical	242.3	80.8						
Difference	**0.7**	**0.8**						
Prob. Error....	5.25	5.25						
	in	in						

TABLE 76

Monohybrid Frequency Distributions Obtained in the F_3 Progenies From F_2 Bearded, Black Hulled, Six-row Parents That Were Heterozygous Black Hulled

	Black Bearded 6-row	White Bearded 6-row	Black Bearded 6-row	White Bearded 6-row	Black Bearded 6-row	White Bearded 6-row	Black Bearded 6-row	White Bearded 6-row
	36-0-286— 73 plants		36-0-287— 72 plants		36-0-288— 127 plants		36-0-289— 53 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**69**	**4**	**53**	**19**	**93**	**34**	**37**	**16**
Theoretical	54.8	18.3	54.0	18.0	95.3	31.8	39.8	13.3
Difference	**14.2**	**14.3**	**1.0**	**1.0**	**2.3**	**2.2**	**2.8**	**2.7**
Prob. Error....	2.50	2.50	2.48	2.48	3.29	3.29	2.13	2.13
	out	out	in	in	in	in	out	out
	36-0-290— 237 plants		36-0-291— 176 plants		36-0-293— 237 plants		36-0-294— 233 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**188**	**49**	**142**	**34**	**178**	**59**	**168**	**65**
Theoretical	177.8	59.3	132.0	44.0	177.8	59.3	174.8	58.3
Difference	**10.2**	**10.3**	**10.0**	**10.0**	**0.2**	**0.3**	**6.8**	**6.7**
Prob. Error....	4.50	4.50	3.88	3.88	4.50	4.50	4.46	4.46
	out	out	out	out	in	in	out	out
	36-0-295— 78 plants		36-0-297— 148 plants		36-0-298— 105 plants		36-0-299— 150 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**53**	**25**	**113**	**35**	**94**	**11**	**116**	**34**
Theoretical	58.5	19.5	111.0	37.0	78.8	26.3	112.5	37.5
Difference	**5.5**	**5.5**	**2.0**	**2.0**	**15.2**	**15.3**	**3.5**	**3.5**
Prob. Error....	2.58	2.58	3.55	3.55	2.99	2.99	3.58	3.58
	out	out	in	in	out	out	in	in

TABLE 76 (Continued)

	Black Bearded 6-row	White Bearded 6-row	Black Bearded 6-row	White Bearded 6-row	Black Bearded 6-row	White Bearded 6-row	Black Bearded 6-row	White Bearded 6-row
	36-0-300—261 plants		36-0-301—94 plants		Total of all progenies—2044 plants			
	(3)	(1)	(3)	(1)	(3)	(1)		
Observed	**197**	**64**	**68**	**26**	**1569**	**475**		
Theoretical	195.8	65.3	70.5	23.5	1533.0	511.0		
Difference	**1.2**	**1.3**	**2.5**	**2.5**	**36.0**	**36.0**		
Prob. Error....	4.72	4.72	2.83	2.83	13.20	13.20		
	in	in	in	in	out	out		

TABLE 77

Monohybrid Frequency Distributions Obtained in the F_3 Progenies From F_2 Bearded, White Hulled, Two-row Parents That Were Heterozygous Two-row

	White Bearded 2-row	White Bearded 6-row	White Bearded 2-row	White Bearded 6-row	White Bearded 2-row	White Bearded 6-row	White Bearded 2-row	White Bearded 6-row
	36-0-302—109 plants		36-0-305—70 plants		36-0-306—87 plants		36-0-307—28 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**81**	**28**	**54**	**16**	**63**	**24**	**22**	**6**
Theoretical	81.8	27.3	52.5	17.5	65.3	21.8	21.0	7.0
Difference	**0.8**	**0.7**	**1.5**	**1.5**	**2.3**	**2.2**	**1.0**	**1.0**
Prob. Error....	3.05	3.05	2.44	2.44	2.72	2.72	1.55	1.55
	in	in	in	in	in	in	in	in
	36-0-308—50 plants		36-0-309—24 plants		36-0-312—19 plants		Total of all progenies—387 plants	
	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)
Observed	**41**	**9**	**15**	**9**	**12**	**7**	**288**	**99**
Theoretical	37.5	12.5	18.0	6.0	14.3	4.8	290.3	96.8
Difference	**3.5**	**3.5**	**3.0**	**3.0**	**2.3**	**2.2**	**2.3**	**2.2**
Prob. Error....	2.07	2.07	1.43	1.43	1.27	1.27	5.75	5.75
	out	out	out	out	out	out	in	in

TABLE 78

SUMMARY OF PROBABLE ERROR STUDIES ON THE F_2 PROGENIES OF WHEAT CROSSES

Cross	Allelomorphic Pairs Involved	Classes Within P. E. Limits	Classes Without P. E. Limits
No. 15. Harvest King♀ × Fultz Mediterranean♂	Red Chaff—White Chaff.....	4	6
No. 16. Harvest King♀ × Fultz Mediterranean♂ (Velvet)	Red Chaff—White Chaff Velvet Chaff—Smooth Chaff..	4	5
No. 11. Harvest King♀ × Turkey Red♂	Beardless—Bearded Red Chaff—White Chaff.....	2	4
No. 13. Harvest King♀ × Turkey Red♂	Beardless—Bearded Red Chaff—White Chaff.....	6	9
No. 19. Turkey Red♀ × Harvest King♂	Beardless—Bearded Red Chaff—White Chaff.....	7	17
No. 20. Turkey Red♀ × Harvest King♂	Beardless—Bearded Red Chaff—White Chaff.....	1	2
No. 21. Turkey Red♀ × Harvest King♂	Beardless—Bearded Red Chaff—White Chaff.....	7	8
No. 22. Turkey Red♀ × Fultz Mediterranean♂	Beardless—Bearded	12	14
No. 23. Turkey Red♀ × Fultz Mediterranean♂	Beardless—Bearded	10	12
No. 24. Turkey Red♀ × Fultz Mediterranean♂	Beardless—Bearded	14	12
Total of all classes	....	67	89
Total of monohybrid crosses	....	40	44
Total of dihybrid crosses	....	27	45

TABLE 79

SUMMARY OF PROBABLE ERROR STUDIES ON THE F_3 GENERATION PROGENIES OF CROSS NO. 13 HARVEST KING♀ × TURKEY RED♂

Characteristics of Selected F_2 Parents	Allelomorphic Pairs Involved	Classes Within P. E. Limits	Classes Without P. E. Limits	Original Data in Table No.
Beardless, Red Chaff..	Beardless—Bearded Red Chaff—White Chaff....	21	27	36
Beardless, Red Chaff..	Red Chaff—White Chaff....	12	8	37
Beardless, Red Chaff..	Beardless—Bearded	20	14	38
Beardless, White Chaff	Beardless—Bearded	12	14	39
Bearded, Red Chaff...	Red Chaff—White Chaff....	16	10	40
Total of all classes	....	81	69	
Total of monohybrid (3:1) classes...		60	46	
Total of dihybrid (9:3:3:1) classes...		21	27	

TABLE 80
SUMMARY OF PROBABLE ERROR STUDIES
ON THE F_3 GENERATION PROGENIES OF CROSS NO 18
HARVEST KING♀ X FULTZ MEDITERRANEAN♂ (VELVET)

Characteristics of Selected F_2 Parents	Allelomorphic Pairs Involved	Classes Within P. E. Limits	Classes Without P. E. Limits	Original Data in Table No.
Red Chaff, Velvet Chaff........	Red Chaff—White Chaff Velvet Chaff—Smooth Chaff	14	19	41
Red Chaff, Velvet Chaff........	Velvet Chaff—Smooth Chaff	2	10	42
Red Chaff, Velvet Chaff........	Red Chaff—White Chaff....	8	4	43
Red Chaff, Smooth Chaff.......	Red Chaff—White Chaff....	8	6	44
White Chaff, Velvet Chaff........	Velvet Chaff—Smooth Chaff	0	10	45
Total of	all classes	32	49	
Total of	monohybrid (3:1) classes...	18	30	
Total of	dihybrid (9:3:3:1) classes...	14	19	

TABLE 81
SUMMARY OF PROBABLE ERROR STUDIES
ON THE F_3 GENERATION PROGENIES OF CROSS NO. 19
TURKEY RED♀ X HARVEST KING♂

Characteristics of Selected F_2 Parents	Allelomorphic Pairs Involved	Classes Within P. E. Limits	Classes Without P. E. Limits	Original Data in Table No.
Beardless, Red Chaff..	Beardless—Bearded Red Chaff—White Chaff....	43	41	46
Beardless, Red Chaff..	Red Chaff—White Chaff....	16	24	47
Beardless, Red Chaff..	Beardless—Bearded	18	24	48
Beardless, White Chaff	Beardless—Bearded	4	16	49
Bearded, Red Chaff...	Red Chaff—White Chaff....	8	12	50
Total of	all classes	89	117	
Total of	monohybrid (3:1) classes...	46	76	
Total of	dihybrid (9:3:3:1) classes...	43	41	

TABLE 82
SUMMARY OF PROBABLE ERROR STUDIES
ON THE F_3 GENERATION PROGENIES OF CROSS NO. 24
TURKEY RED♀ × FULTZ MEDITERRANEAN♂

Characteristics of Selected F_2 Parents	Allelomorphic Pairs Involved	Classes Within P. E. Limits	Classes Without P. E. Limits	Original Data in Table No.
Beardless	Beardless—Bearded	104	94	51
	All monohybrid (3:1) classes			

TABLE 83
SUMMARY OF PROBABLE ERROR STUDIES
ON THE F_3 GENERATION PROGENIES OF CROSSES NO. 30 AND 31
CALIFORNIA♀ × BEARDLESS♂

Characteristics of Selected F_2 Parents	Allelomorphic Pairs Involved	Classes Within P. E. Limits	Classes Without P. E. Limits	Original Data in Table No.
Cross 30. Hooded....	Hoods—Beards	60	44	52
Cross 31. Hooded....	Hoods—Beards	60	42	53
Total of two crosses		120	86	
All monohybrid (3:1) classes........				

TABLE 84
SUMMARY OF PROBABLE ERROR STUDIES
ON THE F_3 GENERATION PROGENIES OF CROSS NO. 32
CALIFORNIA♀ × BLACK HULLED♂

Characteristics of Selected F_2 Parents	Allelomorphic Pairs Involved	Classes Within P. E. Limits	Classes Without P. E. Limits	Original Data in Table No.
Black Hulled, 2-row..	Black Hulled—White Hulled Two-row—Six-row	34	32	54
Black Hulled, 2-row..	Two-row—Six-row	10	12	55
Black Hulled, 2-row..	Black Hulled—White Hulled	16	12	56
Black Hulled, 6-row..	Black Hulled—White Hulled	10	16	57
White Hulled, 2-row..	Two-row—Six-row	16	14	58
Total of all classes		86	86	
Total of monohybrid (3:1) classes...		52	54	
Total of dihybrid (9:3:3:1) classes...		34	32	

SUMMARY OF PROBABLE ERROR STUDIES
ON THE F_3 GENERATION PROGENIES OF CROSS NO. 36
BLACK HULLED♀ × BEARDLESS♂

TABLE 85

Characteristics of Selected F_2 Parents	Allelomorphic Pairs Involved	Classes Within P. E. Limits	Classes Without P. E. Limits	Original Data in Table No.
Hooded, Black Hulled, Two-row	Hoods—Beards Black Hulled—White Hulled Two-row—Six row	81	108	59
Hooded, Black Hulled, Two-row	Hoods—Beards Two-row—Six-row	19	26	60
Hooded, Black Hulled, Two-row	Black Hulled—White Hulled Two-row—Six-row	18	21	61
Hooded, Black Hulled, Two-row	Hoods—Beards Black Hulled—White Hulled	17	13	62
Hooded, Black Hulled, Two-row	Two-row—Six-row	6	6	63
Hooded, Black Hulled, Two-row	Hoods—Beards	8	8	64
Hooded, Black Hulled, Two-row	Black Hulled—White Hulled	20	2	65
Hooded, Black Hulled, Six-row	Hoods—Beards Black Hulled—White Hulled	23	28	66
Hooded, Black Hulled, Six-row	Hoods—Beards	12	14	67
Hooded, Black Hulled, Six-row	Black Hulled—White Hulled	10	14	68
Hooded, White Hulled, Two-row	Hoods—Beards Two-row—Six-row	17	34	69
Hooded, White Hulled, Two-row	Two-row—Six-row	14	4	70
Hooded, White Hulled, Two-row	Hoods—Beards	6	2	71
Hooded, White Hulled, Six-row	Hoods—Beards	6	12	72
Bearded, Black Hulled, Two-row	Black Hulled—White Hulled Two-row—Six-row	24	39	73
Bearded, Black Hulled, Two-row	Two-row—Six-row	14	16	74
Bearded, Black Hulled, Two-row	Black Hulled—White Hulled	0	8	75
Bearded, Black Hulled, Six-row	Black Hulled—White Hulled	14	14	76
Bearded, White Hulled, Two-row	Two-row—Six-row	8	6	77
Total of all classes		317	375	
Total of all monohybrid (3:1) classes		118	106	
Total of all dihybrid (9:3:3:1) classes		118	161	
Total of all trihybrid (27:9:9:9:3:3:3:1) classes		81	108	

TABLE 86

GENERAL SUMMARY OF PROBABLE ERROR STUDIES

	Classes Within P. E. Limits	Classes Without P. E. Limits
Total of all monohybrid (3:1) classes in wheat crosses......	268	290
Total of all monohybrid (3:1) classes in barley crosses.....	290	246
Total of all monohybrid (3:1) classes	558	536
Total of all dihybrid (9:3:3:1) classes in wheat crosses......	105	132
Total of all dihybrid (9:3:3:1) classes in barley crosses.....	152	193
Total of all dihybrid (9:3:3:1) classes	257	325
Total of all trihybrid (27:9:9:9:3:3:3:1) classes in barley cross No. 36..	81	108
Grand total of all classes.................	896	969
Grant total of wheat classes...............	373	422
Grand total of barley classes..............	523	547

TABLE 87
Expected class frequencies for the F_2 3:1 Mendelian Ratio for populations of from 4 to 500

Population	3 Class	1 Class	Population	3 Class	1 Class
1	...	...	51	38.3	12.8
2	...	...	52	39.0	13.0
3	...	...	53	39.8	13.3
4	3.0	1.0	54	40.5	13.5
5	3.8	1.3	55	41.3	13.8
6	4.5	1.5	56	42.0	14.0
7	5.3	1.8	57	42.8	14.3
8	6.0	2.0	58	43.5	14.5
9	6.8	2.3	59	44.3	14.8
10	7.5	2.5	60	45.0	15.0
11	8.3	2.8	61	45.8	15.3
12	9.0	3.0	62	46.5	15.5
13	9.8	3.3	63	47.3	15.8
14	10.5	3.5	64	48.0	16.0
15	11.3	3.8	65	48.8	16.3
16	12.0	4.0	66	49.5	16.5
17	12.8	4.3	67	50.3	16.8
18	13.5	4.5	68	51.0	17.0
19	14.3	4.8	69	51.8	17.3
20	15.0	5.0	70	52.5	17.5
21	15.8	5.3	71	53.3	17.8
22	16.5	5.5	72	54.0	18.0
23	17.3	5.8	73	54.8	18.3
24	18.0	6.0	74	55.5	18.5
25	18.8	6.3	75	56.3	18.8
26	19.5	6.5	76	57.0	19.0
27	20.3	6.8	77	57.8	19.3
28	21.0	7.0	78	58.5	19.5
29	21.8	7.3	79	59.3	19.8
30	22.5	7.5	80	60.0	20.0
31	23.3	7.8	81	60.8	20.3
32	24.0	8.0	82	61.5	20.5
33	24.8	8.3	83	62.3	20.8
34	25.5	8.5	84	63.0	21.0
35	26.3	8.8	85	63.8	21.3
36	27.0	9.0	86	64.5	21.5
37	27.8	9.3	87	65.3	21.8
38	28.5	9.5	88	66.0	22.0
39	29.3	9.8	89	66.8	22.3
40	30.0	10.0	90	67.5	22.5
41	30.8	10.3	91	68.3	22.8
42	31.5	10.5	92	69.0	23.0
43	32.3	10.8	93	69.8	23.3
44	33.0	11.0	94	70.5	23.5
45	33.8	11.3	95	71.3	23.8
46	34.5	11.5	96	72.0	24.0
47	35.3	11.8	97	72.8	24.3
48	36.0	12.0	98	73.5	24.5
49	36.8	12.3	99	74.3	24.8
50	37.5	12.5	100	75.0	25.0

TABLE 87 (Continued)

Population	3 Class	1 Class	Population	3 Class	1 Class
101	75.8	25.3	151	113.3	37.8
102	76.5	25.5	152	114.0	38.0
103	77.3	25.8	153	114.8	38.3
104	78.0	26.0	154	115.5	38.5
105	78.8	26.3	155	116.3	38.8
106	79.5	26.5	156	117.0	39.0
107	80.3	26.8	157	117.8	39.3
108	81.0	27.0	158	118.5	39.5
109	81.8	27.3	159	119.3	39.8
110	82.5	27.5	160	120.0	40.0
111	83.3	27.8	161	120.8	40.3
112	84.0	28.0	162	121.5	40.5
113	84.8	28.3	163	122.3	40.8
114	85.5	28.5	164	123.0	41.0
115	86.3	28.8	165	123.8	41.3
116	87.0	29.0	166	124.5	41.5
117	87.8	29.3	167	125.3	41.8
118	88.5	29.5	168	126.0	42.0
119	89.3	29.8	169	126.8	42.3
120	90.0	30.0	170	127.5	42.5
121	90.8	30.3	171	128.3	42.8
122	91.5	30.5	172	129.0	43.0
123	92.3	30.8	173	129.8	43.3
124	93.0	31.0	174	130.5	43.5
125	93.8	31.3	175	131.3	43.8
126	94.5	31.5	176	132.0	44.0
127	95.3	31.8	177	132.8	44.3
128	96.0	32.0	178	133.5	44.5
129	96.8	32.3	179	134.3	44.8
130	97.5	32.5	180	135.0	45.0
131	98.3	32.8	181	135.8	45.3
132	99.0	33.0	182	136.5	45.5
133	99.8	33.3	183	137.3	45.8
134	100.5	33.5	184	138.0	46.0
135	101.3	33.8	185	138.8	46.3
136	102.0	34.0	186	139.5	46.5
137	102.8	34.3	187	140.3	46.8
138	103.5	34.5	188	141.0	47.0
139	104.3	34.8	189	141.8	47.3
140	105.0	35.0	190	142.5	47.5
141	105.8	35.3	191	143.3	47.8
142	106.5	35.5	192	144.0	48.0
143	107.3	35.8	193	144.8	48.3
144	108.0	36.0	194	145.5	48.5
145	108.8	36.3	195	146.3	48.8
146	109.5	36.5	196	147.0	49.0
147	110.3	36.8	197	147.8	49.3
148	111.0	37.0	198	148.5	49.5
149	111.8	37.3	199	149.3	49.8
150	112.5	37.5	200	150.0	50.0

TABLE 87 (Continued)

Population	3 Class	1 Class	Population	3 Class	1 Class
201	150.8	50.3	251	188.3	62.8
202	151.5	50.5	252	189.0	63.0
203	152.3	50.8	253	189.8	63.3
204	153.0	51.0	254	190.5	63.5
205	153.8	51.3	255	191.3	63.8
206	154.5	51.5	256	192.0	64.0
207	155.3	51.8	257	192.8	64.3
208	156.0	52.0	258	193.5	64.5
209	156.8	52.3	259	194.3	64.8
210	157.5	52.5	260	195.0	65.0
211	158.3	52.8	261	195.8	65.3
212	159.0	53.0	262	196.5	65.5
213	159.8	53.3	263	197.3	65.8
214	160.5	53.5	264	198.0	66.0
215	161.3	53.8	265	198.8	66.3
216	162.0	54.0	266	199.5	66.5
217	162.8	54.3	267	200.3	66.8
218	163.5	54.5	268	201.0	67.0
219	164.3	54.8	269	201.8	67.3
220	165.0	55.0	270	202.5	67.5
221	165.8	55.3	271	203.3	67.8
222	166.5	55.5	272	204.0	68.0
223	167.3	55.8	273	204.8	68.3
224	168.0	56.0	274	205.5	68.5
225	168.8	56.3	275	206.3	68.8
226	169.5	56.5	276	207.0	69.0
227	170.3	56.8	277	207.8	69.3
228	171.0	57.0	278	208.5	69.5
229	171.8	57.3	279	209.3	69.8
230	172.5	57.5	280	210.0	70.0
231	173.3	57.8	281	210.8	70.3
232	174.0	58.0	282	211.5	70.5
233	174.8	58.3	283	212.3	70.8
234	175.5	58.5	284	213.0	71.0
235	176.3	58.8	285	213.8	71.3
236	177.0	59.0	286	214.5	71.5
237	177.8	59.3	287	215.3	71.8
238	178.5	59.5	288	216.0	72.0
239	179.3	59.8	289	216.8	72.3
240	180.0	60.0	290	217.5	72.5
241	180.8	60.3	291	218.3	72.8
242	181.5	60.5	292	219.0	73.0
243	182.3	60.8	293	219.8	73.3
244	183.0	61.0	294	220.5	73.5
245	183.8	61.3	295	221.3	73.8
246	184.5	61.5	296	222.0	74.0
247	185.3	61.8	297	222.8	74.3
248	186.0	62.0	298	223.5	74.5
249	186.8	62.3	299	224.3	74.8
250	187.5	62.5	300	225.0	75.0

TABLE 87 (Continued)

Population	3 Class	1 Class	Population	3 Class	1 Class
301	225.8	75.3	351	263.3	87.8
302	226.5	75.5	352	264.0	88.0
303	227.3	75.8	353	264.8	88.3
304	228.0	76.0	354	265.5	88.5
305	228.8	76.3	355	266.3	88.8
306	229.5	76.5	356	267.0	89.0
307	230.3	76.8	357	267.8	89.3
308	231.0	77.0	358	268.5	89.5
309	231.8	77.3	359	269.3	89.8
310	232.5	77.5	360	270.0	90.0
311	233.3	77.8	361	270.8	90.3
312	234.0	78.0	362	271.5	90.5
313	234.8	78.3	363	272.3	90.8
314	235.5	78.5	364	273.0	91.0
315	236.3	78.8	365	273.8	91.3
316	237.0	79.0	366	274.5	91.5
317	237.8	79.3	367	275.3	91.8
318	238.5	79.5	368	276.0	92.0
319	239.3	79.8	369	276.8	92.3
320	240.0	80.0	370	277.5	92.5
321	240.8	80.3	371	278.3	92.8
322	241.5	80.5	372	279.0	93.0
323	242.3	80.8	373	279.8	93.3
324	243.0	81.0	374	280.5	93.5
325	243.8	81.3	375	281.3	93.8
326	244.5	81.5	376	282.0	94.0
327	245.3	81.8	377	282.8	94.3
328	246.0	82.0	378	283.5	94.5
329	246.8	82.3	379	284.3	94.8
330	247.5	82.5	380	285.0	95.0
331	248.3	82.8	381	285.8	95.3
332	249.0	83.0	382	286.5	95.5
333	249.8	83.3	383	287.3	95.8
334	250.5	83.5	384	288.0	96.0
335	251.3	83.8	385	288.8	96.3
336	252.0	84.0	386	289.5	96.5
337	252.8	84.3	387	290.3	96.8
338	253.5	84.5	388	291.0	97.0
339	254.3	84.8	389	291.8	97.3
340	255.0	85.0	390	292.5	97.5
341	255.8	85.3	391	293.3	97.8
342	256.5	85.5	392	294.0	98.0
343	257.3	85.8	393	294.8	98.3
344	258.0	86.0	394	295.5	98.5
345	258.8	86.3	395	296.3	98.8
346	259.5	86.5	396	297.0	99.0
347	260.3	86.8	397	297.8	99.3
348	261.0	87.0	398	298.5	99.5
349	261.8	87.3	399	299.3	99.8
350	262.5	87.5	400	300.0	100.0

TABLE 87 (Continued)

Population	3 Class	1 Class	Population	3 Class	1 Class
401	300.8	100.3	451	338.3	112.8
402	301.5	100.5	452	339.0	113.0
403	302.3	100.8	453	339.8	113.3
404	303.0	101.0	454	340.5	113.5
405	303.8	101.3	455	341.3	113.8
406	304.5	101.5	456	342.0	114.0
407	305.3	101.8	457	342.8	114.3
408	306.0	102.0	458	343.5	114.5
409	306.8	102.3	459	344.3	114.8
410	307.5	102.5	460	345.0	115.0
411	308.3	102.8	461	345.8	115.3
412	309.0	103.0	462	346.5	115.5
413	309.8	103.3	463	347.3	115.8
414	310.5	103.5	464	348.0	116.0
415	311.3	103.8	465	348.8	116.3
416	312.0	104.0	466	349.5	116.5
417	312.8	104.3	467	350.3	116.8
418	313.5	104.5	468	351.0	117.0
419	314.3	104.8	469	351.8	117.3
420	315.0	105.0	470	352.5	117.5
421	315.8	105.3	471	353.3	117.8
422	316.5	105.5	472	354.0	118.0
423	317.3	105.8	473	354.8	118.3
424	318.0	106.0	474	355.5	118.5
425	318.8	106.3	475	356.3	118.8
426	319.5	106.5	476	357.0	119.0
427	320.3	106.8	477	357.8	119.3
428	321.0	107.0	478	358.5	119.5
429	321.8	107.3	479	359.3	119.8
430	322.5	107.5	480	360.0	120.0
431	323.3	107.8	481	360.8	120.3
432	324.0	108.0	482	361.5	120.5
433	324.8	108.3	483	362.3	120.8
434	325.5	108.5	484	363.0	121.0
435	326.3	108.8	485	363.8	121.3
436	327.0	109.0	486	364.5	121.5
437	327.8	109.3	487	365.3	121.8
438	328.5	109.5	488	366.0	122.0
439	329.3	109.8	489	366.8	122.3
440	330.0	110.0	490	367.5	122.5
441	330.8	110.3	491	368.3	122.8
442	331.5	110.5	492	369.0	123.0
443	332.3	110.8	493	369.8	123.3
444	333.0	111.0	494	370.5	123.5
445	333.8	111.3	495	371.3	123.8
446	334.5	111.5	496	372.0	124.0
447	335.3	111.8	497	372.8	124.3
448	336.0	112.0	498	373.5	124.5
449	336.8	112.3	499	374.3	124.8
450	337.5	112.5	500	375.0	125.0

TABLE 88

Expected class frequencies for the F_2 9:3:3:1 Mendelian ratio for populations of from 16 to 500

Population	9 Class	3 Class	1 Class	Population	9 Class	3 Class	1 Class
1	...	...	...	51	28.7	9.6	3.2
2	...	...	...	52	29.3	9.8	3.3
3	...	...	...	53	29.8	9.9	3.3
4	...	...	...	54	30.4	10.1	3.4
5	...	...	...	55	30.9	10.3	3.4
6	...	...	...	56	31.5	10.5	3.5
7	...	...	...	57	32.1	10.7	3.6
8	...	...	...	58	32.6	10.9	3.6
9	...	...	...	59	33.2	11.1	3.7
10	...	...	...	60	33.8	11.3	3.8
11	...	...	...	61	34.3	11.4	3.8
12	...	...	...	62	34.9	11.6	3.9
13	...	...	...	63	35.4	11.8	3.9
14	...	...	...	64	36.0	12.0	4.0
15	...	...	...	65	36.6	12.2	4.1
16	9.0	3.0	1.0	66	37.1	12.4	4.1
17	9.6	3.2	1.1	67	37.7	12.6	4.2
18	10.1	3.4	1.1	68	38.3	12.8	4.3
19	10.7	3.6	1.2	69	38.8	12.9	4.3
20	11.3	3.8	1.3	70	39.4	13.1	4.4
21	11.8	3.9	1.3	71	39.9	13.3	4.4
22	12.4	4.1	1.4	72	40.5	13.5	4.5
23	12.9	4.3	1.4	73	41.1	13.7	4.6
24	13.5	4.5	1.5	74	41.6	13.9	4.6
25	14.1	4.7	1.6	75	42.2	14.1	4.7
26	14.6	4.9	1.6	76	42.8	14.3	4.8
27	15.2	5.1	1.7	77	43.3	14.4	4.8
28	15.8	5.3	1.8	78	43.9	14.6	4.9
29	16.3	5.4	1.8	79	44.4	14.8	4.9
30	16.9	5.6	1.9	80	45.0	15.0	5.0
31	17.4	5.8	1.9	81	45.6	15.2	5.1
32	18.0	6.0	2.0	82	46.1	15.4	5.1
33	18.6	6.2	2.1	83	46.7	15.6	5.2
34	19.1	6.4	2.1	84	47.3	15.8	5.3
35	19.7	6.6	2.2	85	47.8	15.9	5.3
36	20.3	6.8	2.3	86	48.4	16.1	5.4
37	20.8	6.9	2.3	87	48.9	16.3	5.4
38	21.4	7.1	2.4	88	49.5	16.5	5.5
39	21.9	7.3	2.4	89	50.1	16.7	5.6
40	22.5	7.5	2.5	90	50.6	16.9	5.6
41	23.1	7.7	2.6	91	51.2	17.1	5.7
42	23.6	7.9	2.6	92	51.8	17.3	5.8
43	24.2	8.1	2.7	93	52.3	17.4	5.8
44	24.8	8.3	2.8	94	52.9	17.6	5.9
45	25.3	8.4	2.8	95	53.4	17.8	5.9
46	25.9	8.6	2.9	96	54.0	18.0	6.0
47	26.4	8.8	2.9	97	54.6	18.2	6.1
48	27.0	9.0	3.0	98	55.1	18.4	6.1
49	27.6	9.2	3.1	99	55.7	18.6	6.2
50	28.1	9.4	3.1	100	56.3	18.8	6.3

TABLE 88 (Continued)

Population	9 Class	3 Class	1 Class	Population	9 Class	3 Class	1 Class
101	56.8	18.9	6.3	151	84.9	28.3	9.4
102	57.4	19.1	6.4	152	85.5	28.5	9.5
103	57.9	19.3	6.4	153	86.1	28.7	9.6
104	58.5	19.5	6.5	154	86.6	28.9	9.6
105	59.1	19.7	6.6	155	87.2	29.1	9.7
106	59.6	19.9	6.6	156	87.8	29.3	9.8
107	60.2	20.1	6.7	157	88.3	29.4	9.8
108	60.8	20.3	6.8	158	88.9	29.6	9.9
109	61.3	20.4	6.8	159	89.4	29.8	9.9
110	61.9	20.6	6.9	160	90.0	30.0	10.0
111	62.4	20.8	6.9	161	90.6	30.2	10.1
112	63.0	21.0	7.0	162	91.1	30.4	10.1
113	63.6	21.2	7.1	163	91.7	30.6	10.2
114	64.1	21.4	7.1	164	92.3	30.8	10.3
115	64.7	21.6	7.2	165	92.8	30.9	10.3
116	65.3	21.8	7.3	166	93.4	31.1	10.4
117	65.8	21.9	7.3	167	93.9	31.3	10.4
118	66.4	22.1	7.4	168	94.5	31.5	10.5
119	66.9	22.3	7.4	169	95.1	31.7	10.6
120	67.5	22.5	7.5	170	95.6	31.9	10.6
121	68.1	22.7	7.6	171	96.2	32.1	10.7
122	68.6	22.9	7.6	172	96.8	32.3	10.8
123	69.2	23.1	7.7	173	97.3	32.4	10.8
124	69.8	23.3	7.8	174	97.9	32.6	10.9
125	70.3	23.4	7.8	175	98.4	32.8	10.9
126	70.9	23.6	7.9	176	99.0	33.0	11.0
127	71.4	23.8	7.9	177	99.6	33.2	11.1
128	72.0	24.0	8.0	178	100.1	33.4	11.1
129	72.6	24.2	8.1	179	100.7	33.6	11.2
130	73.1	24.4	8.1	180	101.3	33.8	11.3
131	73.7	24.6	8.2	181	101.8	33.9	11.3
132	74.3	24.8	8.3	182	102.4	34.1	11.4
133	74.8	24.9	8.3	183	102.9	34.3	11.4
134	75.4	25.1	8.4	184	103.5	34.5	11.5
135	75.9	25.3	8.4	185	104.1	34.7	11.6
136	76.5	25.5	8.5	186	104.6	34.9	11.6
137	77.1	25.7	8.6	187	105.2	35.1	11.7
138	77.6	25.9	8.6	188	105.8	35.3	11.8
139	78.2	26.1	8.7	189	106.3	35.4	11.8
140	78.8	26.3	8.8	190	106.9	35.6	11.9
141	79.3	26.4	8.8	191	107.4	35.8	11.9
142	79.9	26.6	8.9	192	108.0	36.0	12.0
143	80.4	26.8	8.9	193	108.6	36.2	12.1
144	81.0	27.0	9.0	194	109.1	36.4	12.1
145	81.6	27.2	9.1	195	109.7	36.6	12.2
146	82.1	27.4	9.1	196	110.3	36.8	12.3
147	82.7	27.6	9.2	197	110.8	36.9	12.3
148	83.3	27.8	9.3	198	111.4	37.1	12.4
149	83.8	27.9	9.3	199	111.9	37.3	12.4
150	84.4	28.1	9.4	200	112.5	37.5	12.5

TABLE 88 (Continued)

Population	9 Class	3 Class	1 Class	Population	9 Class	3 Class	1 Class
201	113.1	37.7	12.6	251	141.2	47.1	15.7
202	113.6	37.9	12.6	252	141.8	47.3	15.8
203	114.2	38.1	12.7	253	142.3	47.4	15.8
204	114.8	38.3	12.8	254	142.9	47.6	15.9
205	115.3	38.4	12.8	255	143.4	47.8	15.9
206	115.9	38.6	12.9	256	144.0	48.0	16.0
207	116.4	38.8	12.9	257	144.6	48.2	16.1
208	117.0	39.0	13.0	258	145.1	48.4	16.1
209	117.6	39.2	13.1	259	145.7	48.6	16.2
210	118.1	39.4	13.1	260	146.3	48.8	16.3
211	118.7	39.6	13.2	261	146.8	48.9	16.3
212	119.3	39.8	13.3	262	147.4	49.1	16.4
213	119.8	39.9	13.3	263	147.9	49.3	16.4
214	120.4	40.1	13.4	264	148.5	49.5	16.5
215	120.9	40.3	13.4	265	149.1	49.7	16.6
216	121.5	40.5	13.5	266	149.6	49.9	16.6
217	122.1	40.7	13.6	267	150.2	50.1	16.7
218	122.6	40.9	13.6	268	150.8	50.3	16.8
219	123.2	41.1	13.7	269	151.3	50.4	16.8
220	123.8	41.3	13.8	270	151.9	50.6	16.9
221	124.3	41.4	13.8	271	152.4	50.8	16.9
222	124.9	41.6	13.9	272	153.0	51.0	17.0
223	125.4	41.8	13.9	273	153.6	51.2	17.1
224	126.0	42.0	14.0	274	154.1	51.4	17.1
225	126.6	42.2	14.1	275	154.7	51.6	17.2
226	127.1	42.4	14.1	276	155.3	51.8	17.3
227	127.7	42.6	14.2	277	155.8	51.9	17.3
228	128.3	42.8	14.3	278	156.4	52.1	17.4
229	128.8	42.9	14.3	279	156.9	52.3	17.4
230	129.4	43.1	14.4	280	157.5	52.5	17.5
231	129.9	43.3	14.4	281	158.1	52.7	17.6
232	130.5	43.5	14.5	282	158.6	52.9	17.6
233	131.1	43.7	14.6	283	159.2	53.1	17.7
234	131.6	43.9	14.6	284	159.8	53.3	17.8
235	132.2	44.1	14.7	285	160.3	53.4	17.8
236	132.8	44.3	14.8	286	160.9	53.6	17.9
237	133.3	44.4	14.8	287	161.4	53.8	17.9
238	133.9	44.6	14.9	288	162.0	54.0	18.0
239	134.4	44.8	14.9	289	162.6	54.2	18.1
240	135.0	45.0	15.0	290	163.1	54.4	18.1
241	135.6	45.2	15.1	291	163.7	54.6	18.2
242	136.1	45.4	15.1	292	164.3	54.8	18.3
243	136.7	45.6	15.2	293	164.8	54.9	18.3
244	137.3	45.8	15.3	294	165.4	55.1	18.4
245	137.8	45.9	15.3	295	165.9	55.3	18.4
246	138.4	46.1	15.4	296	166.5	55.5	18.5
247	138.9	46.3	15.4	297	167.1	55.7	18.6
248	139.5	46.5	15.5	298	167.6	55.9	18.6
249	140.1	46.7	15.6	299	168.2	56.1	18.7
250	140.6	46.9	15.6	300	168.8	56.3	18.8

TABLE 88 (Continued)

Population	9 Class	3 Class	1 Class	Population	9 Class	3 Class	1 Class
301	169.3	56.4	18.8	351	197.4	65.8	21.9
302	169.9	56.6	18.9	352	198.0	66.0	22.0
303	170.4	56.8	18.9	353	198.6	66.2	22.1
304	171.0	57.0	19.0	354	199.1	66.4	22.1
305	171.6	57.2	19.1	355	199.7	66.6	22.2
306	172.1	57.4	19.1	356	200.3	66.8	22.3
307	172.7	57.6	19.2	357	200.8	66.9	22.3
308	173.3	57.8	19.3	358	201.4	67.1	22.4
309	173.8	57.9	19.3	359	201.9	67.3	22.4
310	174.4	58.1	19.4	360	202.5	67.5	22.5
311	174.9	58.3	19.4	361	203.1	67.7	22.6
312	175.5	58.5	19.5	362	203.6	67.9	22.6
313	176.1	58.7	19.6	363	204.2	68.1	22.7
314	176.6	58.9	19.6	364	204.8	68.3	22.8
315	177.2	59.1	19.7	365	205.3	68.4	22.8
316	177.8	59.3	19.8	366	205.9	68.6	22.9
317	178.3	59.4	19.8	367	206.4	68.8	22.9
318	178.9	59.6	19.9	368	207.0	69.0	23.0
319	179.4	59.8	19.9	369	207.6	69.2	23.1
320	180.0	60.0	20.0	370	208.1	69.4	23.1
321	180.6	60.2	20.1	371	208.7	69.6	23.2
322	181.1	60.4	20.1	372	209.3	69.8	23.3
323	181.7	60.6	20.2	373	209.8	69.9	23.3
324	182.3	60.8	20.3	374	210.4	70.1	23.4
325	182.8	60.9	20.3	375	210.9	70.3	23.4
326	183.4	61.1	20.4	376	211.5	70.5	23.5
327	183.9	61.3	20.4	377	212.1	70.7	23.6
328	184.5	61.5	20.5	378	212.6	70.9	23.6
329	185.1	61.7	20.6	379	213.2	71.1	23.7
330	185.6	61.9	20.6	380	213.8	71.3	23.8
331	186.2	62.1	20.7	381	214.3	71.4	23.8
332	186.8	62.3	20.8	382	214.9	71.6	23.9
333	187.3	62.4	20.8	383	215.4	71.8	23.9
334	187.9	62.6	20.9	384	216.0	72.0	24.0
335	188.4	62.8	20.9	385	216.6	72.2	24.1
336	189.0	63.0	21.0	386	217.1	72.4	24.1
337	189.6	63.2	21.1	387	217.7	72.6	24.2
338	190.1	63.4	21.1	388	218.3	72.8	24.3
339	190.7	63.6	21.2	389	218.8	72.9	24.3
340	191.3	63.8	21.3	390	219.4	73.1	24.4
341	191.8	63.9	21.3	391	219.9	73.3	24.4
342	192.4	64.1	21.4	392	220.5	73.5	24.5
343	192.9	64.3	21.4	393	221.1	73.7	24.6
344	193.5	64.5	21.5	394	221.6	73.9	24.6
345	194.1	64.7	21.6	395	222.2	74.1	24.7
346	194.6	64.9	21.6	396	222.8	74.3	24.8
347	195.2	65.1	21.7	397	223.3	74.4	24.8
348	195.8	65.3	21.8	398	223.9	74.6	24.9
349	196.3	65.4	21.8	399	224.4	74.8	24.9
350	196.9	65.6	21.9	400	225.0	75.0	25.0

TABLE 88 (Continued)

Population	9 Class	3 Class	1 Class	Population	9 Class	3 Class	1 Class
401	225.6	75.2	25.1	451	253.7	84.6	28.2
402	226.1	75.4	25.1	452	254.3	84.8	28.3
403	226.7	75.6	25.2	453	254.8	84.9	28.3
404	227.3	75.8	25.3	454	255.4	85.1	28.4
405	227.8	75.9	25.3	455	255.9	85.3	28.4
406	228.4	76.1	25.4	456	256.5	85.5	28.5
407	228.9	76.3	25.4	457	257.1	85.7	28.6
408	229.5	76.5	25.5	458	257.6	85.9	28.6
409	230.1	76.7	25.6	459	258.2	86.1	28.7
410	230.6	76.9	25.6	460	258.8	86.3	28.8
411	231.2	77.1	25.7	461	259.3	86.4	28.8
412	231.8	77.3	25.8	462	259.9	86.6	28.9
413	232.3	77.4	25.8	463	260.4	86.8	28.9
414	232.9	77.6	25.9	464	261.0	87.0	29.0
415	233.4	77.8	25.9	465	261.6	87.2	29.1
416	234.0	78.0	26.0	466	262.1	87.4	29.1
417	234.6	78.2	26.1	467	262.7	87.6	29.2
418	235.1	78.4	26.1	468	263.3	87.8	29.3
419	235.7	78.6	26.2	469	263.8	87.9	29.3
420	236.3	78.8	26.3	470	264.4	88.1	29.4
421	236.8	78.9	26.3	471	264.9	88.3	29.4
422	237.4	79.1	26.4	472	265.5	88.5	29.5
423	237.9	79.3	26.4	473	266.1	88.7	29.6
424	238.5	79.5	26.5	474	266.6	88.9	29.6
425	239.1	79.7	26.6	475	267.2	89.1	29.7
426	239.6	79.9	26.6	476	267.8	89.3	29.8
427	240.2	80.1	26.7	477	268.3	89.4	29.8
428	240.8	80.3	26.8	478	268.9	89.6	29.9
429	241.3	80.4	26.8	479	269.4	89.8	29.9
430	241.9	80.6	26.9	480	270.0	90.0	30.0
431	242.4	80.8	26.9	481	270.6	90.2	30.1
432	243.0	81.0	27.0	482	271.1	90.4	30.1
433	243.6	81.2	27.1	483	271.7	90.6	30.2
434	244.1	81.4	27.1	484	272.3	90.8	30.3
435	244.7	81.6	27.2	485	272.8	90.9	30.3
436	245.3	81.8	27.3	486	273.4	91.1	30.4
437	245.8	81.9	27.3	487	273.9	91.3	30.4
438	246.4	82.1	27.4	488	274.5	91.5	30.5
439	246.9	82.3	27.4	489	275.1	91.7	30.6
440	247.5	82.5	27.5	490	275.6	91.9	30.6
441	248.1	82.7	27.6	491	276.2	92.1	30.7
442	248.6	82.9	27.6	492	276.8	92.3	30.8
443	249.2	83.1	27.7	493	277.3	92.4	30.8
444	249.8	83.3	27.8	494	277.9	92.6	30.9
445	250.3	83.4	27.8	495	278.4	92.8	30.9
446	250.9	83.6	27.9	496	279.0	93.0	31.0
447	251.4	83.8	27.9	497	279.6	93.2	31.1
448	252.0	84.0	28.0	498	280.1	93.4	31.1
449	252.6	84.2	28.1	499	280.7	93.6	31.2
450	253.1	84.4	28.1	500	281.3	93.8	31.3

TABLE 89

Expected class frequencies for the F_2 27:9:9:9:3:3:3:1 Mendelian ratio for populations of from 64 to 500

Population	27 Class	9 Class	3 Class	1 Class	Population	27 Class	9 Class	3 Class	1 Class
1	...	...	...	..	51	...	...	...	..
2	...	...	...	..	52	...	...	...	..
3	...	...	...	..	53	...	...	...	..
4	...	...	...	..	54	...	...	...	..
5	...	...	...	..	55	...	...	...	..
6	...	...	...	..	56	...	...	...	..
7	...	...	...	..	57	...	...	...	..
8	...	...	...	..	58	...	...	...	..
9	...	...	...	..	59	...	...	...	..
10	...	...	...	..	60	...	...	...	..
11	...	...	...	..	61	...	...	...	..
12	...	...	...	..	62	...	...	...	..
13	...	...	...	..	63	...	...	...	..
14	...	...	...	..	64	27.0	9.0	3.0	1.0
15	...	...	...	..	65	27.4	9.1	3.0	1.0
16	...	...	...	..	66	27.8	9.3	3.1	1.0
17	...	...	...	..	67	28.3	9.4	3.1	1.0
18	...	...	...	..	68	28.7	9.6	3.2	1.1
19	...	...	...	..	69	29.1	9.7	3.2	1.1
20	...	...	...	..	70	29.5	9.8	3.3	1.1
21	...	...	...	..	71	30.0	10.0	3.3	1.1
22	...	...	...	..	72	30.4	10.1	3.4	1.1
23	...	...	...	..	73	30.8	10.3	3.4	1.1
24	...	...	...	..	74	31.2	10.4	3.5	1.2
25	...	...	...	..	75	31.6	10.5	3.5	1.2
26	...	...	...	..	76	32.1	10.7	3.6	1.2
27	...	...	...	..	77	32.5	10.8	3.6	1.2
28	...	...	...	..	78	32.9	11.0	3.7	1.2
29	...	...	...	..	79	33.3	11.1	3.7	1.2
30	...	...	...	..	80	33.8	11.3	3.8	1.3
31	...	...	...	..	81	34.2	11.4	3.8	1.3
32	...	...	...	..	82	34.6	11.5	3.8	1.3
33	...	...	...	..	83	35.0	11.7	3.9	1.3
34	...	...	...	..	84	35.4	11.8	3.9	1.3
35	...	...	...	..	85	35.9	12.0	4.0	1.3
36	...	...	...	..	86	36.3	12.1	4.0	1.3
37	...	...	...	..	87	36.7	12.2	4.1	1.4
38	...	...	...	..	88	37.1	12.4	4.1	1.4
39	...	...	...	..	89	37.5	12.5	4.2	1.4
40	...	...	...	..	90	38.0	12.7	4.2	1.4
41	...	...	...	..	91	38.4	12.8	4.3	1.4
42	...	...	...	..	92	38.8	12.9	4.3	1.4
43	...	...	...	..	93	39.2	13.1	4.4	1.5
44	...	...	...	..	94	39.7	13.2	4.4	1.5
45	...	...	...	..	95	40.1	13.4	4.5	1.5
46	...	...	...	..	96	40.5	13.5	4.5	1.5
47	...	...	...	..	97	40.9	13.6	4.5	1.5
48	...	...	...	..	98	41.3	13.8	4.6	1.5
49	...	...	...	..	99	41.8	13.9	4.6	1.5
50	...	...	...	..	100	42.2	14.1	4.7	1.6

TABLE 89 (Continued)

Population	27 Class	9 Class	3 Class	1 Class	Population	27 Class	9 Class	3 Class	1 Class
101	42.6	14.2	4.7	1.6	151	63.7	21.2	7.1	2.4
102	43.0	14.3	4.8	1.6	152	64.1	21.4	7.1	2.4
103	43.5	14.5	4.8	1.6	153	64.5	21.5	7.2	2.4
104	43.9	14.6	4.9	1.6	154	65.0	21.7	7.2	2.4
105	44.3	14.8	4.9	1.6	155	65.4	21.8	7.3	2.4
106	44.7	14.9	5.0	1.7	156	65.8	21.9	7.3	2.4
107	45.1	15.0	5.0	1.7	157	66.2	22.1	7.4	2.5
108	45.6	15.2	5.1	1.7	158	66.7	22.2	7.4	2.5
109	46.0	15.3	5.1	1.7	159	67.1	22.4	7.5	2.5
110	46.4	15.5	5.2	1.7	160	67.5	22.5	7.5	2.5
111	46.8	15.6	5.2	1.7	161	67.9	22.6	7.5	2.5
112	47.3	15.8	5.3	1.8	162	68.3	22.8	7.6	2.5
113	47.7	15.9	5.3	1.8	163	68.8	22.9	7.6	2.5
114	48.1	16.0	5.3	1.8	164	69.2	23.1	7.7	2.6
115	48.5	16.2	5.4	1.8	165	69.6	23.2	7.7	2.6
116	48.9	16.3	5.4	1.8	166	70.0	23.3	7.8	2.6
117	49.4	16.5	5.5	1.8	167	70.5	23.5	7.8	2.6
118	49.8	16.6	5.5	1.8	168	70.9	23.6	7.9	2.6
119	50.2	16.7	5.6	1.9	169	71.3	23.8	7.9	2.6
120	50.6	16.9	5.6	1.9	170	71.7	23.9	8.0	2.7
121	51.0	17.0	5.7	1.9	171	72.1	24.0	8.0	2.7
122	51.5	17.2	5.7	1.9	172	72.6	24.2	8.1	2.7
123	51.9	17.3	5.8	1.9	173	73.0	24.3	8.1	2.7
124	52.3	17.4	5.8	1.9	174	73.4	24.5	8.2	2.7
125	52.7	17.6	5.9	2.0	175	73.8	24.6	8.2	2.7
126	53.2	17.7	5.9	2.0	176	74.3	24.8	8.3	2.8
127	53.6	17.9	6.0	2.0	177	74.7	24.9	8.3	2.8
128	54.0	18.0	6.0	2.0	178	75.1	25.0	8.3	2.8
129	54.4	18.1	6.0	2.0	179	75.5	25.2	8.4	2.8
130	54.8	18.3	6.1	2.0	180	75.9	25.3	8.4	2.8
131	55.3	18.4	6.1	2.0	181	76.4	25.5	8.5	2.8
132	55.7	18.6	6.2	2.1	182	76.8	25.6	8.5	2.8
133	56.1	18.7	6.2	2.1	183	77.2	25.7	8.6	2.9
134	56.5	18.8	6.3	2.1	184	77.6	25.9	8.6	2.9
135	57.0	19.0	6.3	2.1	185	78.0	26.0	8.7	2.9
136	57.4	19.1	6.4	2.1	186	78.5	26.2	8.7	2.9
137	57.8	19.3	6.4	2.1	187	78.9	26.3	8.8	2.9
138	58.2	19.4	6.5	2.2	188	79.3	26.4	8.8	2.9
139	58.6	19.5	6.5	2.2	189	79.7	26.6	8.9	3.0
140	59.1	19.7	6.6	2.2	190	80.2	26.7	8.9	3.0
141	59.5	19.8	6.6	2.2	191	80.6	26.9	9.0	3.0
142	59.9	20.0	6.7	2.2	192	81.0	27.0	9.0	3.0
143	60.3	20.1	6.7	2.2	193	81.4	27.1	9.0	3.0
144	60.8	20.3	6.8	2.3	194	81.8	27.3	9.1	3.0
145	61.2	20.4	6.8	2.3	195	82.3	27.4	9.1	3.0
146	61.6	20.5	6.8	2.3	196	82.7	27.6	9.2	3.1
147	62.0	20.7	6.9	2.3	197	83.1	27.7	9.2	3.1
148	62.4	20.8	6.9	2.3	198	83.5	27.8	9.3	3.1
149	62.9	21.0	7.0	2.3	199	84.0	28.0	9.3	3.1
150	63.3	21.1	7.0	2.3	200	84.4	28.1	9.4	3.1

TABLE 89 (Continued)

Population	27 Class	9 Class	3 Class	1 Class	Population	27 Class	9 Class	3 Class	1 Class
201	84.8	28.3	9.4	3.1	251	105.9	35.3	11.8	3.9
202	85.2	28.4	9.5	3.2	252	106.3	35.4	11.8	3.9
203	85.6	28.5	9.5	3.2	253	106.7	35.6	11.9	4.0
204	86.1	28.7	9.6	3.2	254	107.2	35.7	11.9	4.0
205	86.5	28.8	9.6	3.2	255	107.6	35.9	12.0	4.0
206	86.9	29.0	9.7	3.2	256	108.0	36.0	12.0	4.0
207	87.3	29.1	9.7	3.2	257	108.4	36.1	12.0	4.0
208	87.8	29.3	9.8	3.3	258	108.8	36.3	12.1	4.0
209	88.2	29.4	9.8	3.3	259	109.3	36.4	12.1	4.0
210	88.6	29.5	9.8	3.3	260	109.7	36.6	12.2	4.1
211	89.0	29.7	9.9	3.3	261	110.1	36.7	12.2	4.1
212	89.4	29.8	9.9	3.3	262	110.5	36.8	12.3	4.1
213	89.9	30.0	10.0	3.3	263	111.0	37.0	12.3	4.1
214	90.3	30.1	10.0	3.3	264	111.4	37.1	12.4	4.1
215	90.7	30.2	10.1	3.4	265	111.8	37.3	12.4	4.1
216	91.1	30.4	10.1	3.4	266	112.2	37.4	12.5	4.2
217	91.5	30.5	10.2	3.4	267	112.6	37.5	12.5	4.2
218	92.0	30.7	10.2	3.4	268	113.1	37.7	12.6	4.2
219	92.4	30.8	10.3	3.4	269	113.5	37.8	12.6	4.2
220	92.8	30.9	10.3	3.4	270	113.9	38.0	12.7	4.2
221	93.2	31.1	10.4	3.5	271	114.3	38.1	12.7	4.2
222	93.7	31.2	10.4	3.5	272	114.8	38.3	12.8	4.3
223	94.1	31.4	10.5	3.5	273	115.2	38.4	12.8	4.3
224	94.5	31.5	10.5	3.5	274	115.6	38.5	12.8	4.3
225	94.9	31.6	10.5	3.5	275	116.0	38.7	12.9	4.3
226	95.3	31.8	10.6	3.5	276	116.4	38.8	12.9	4.3
227	95.8	31.9	10.6	3.5	277	116.9	39.0	13.0	4.3
228	96.2	32.1	10.7	3.6	278	117.3	39.1	13.0	4.3
229	96.6	32.2	10.7	3.6	279	117.7	39.2	13.1	4.4
230	97.0	32.3	10.8	3.6	280	118.1	39.4	13.1	4.4
231	97.5	32.5	10.8	3.6	281	118.5	39.5	13.2	4.4
232	97.9	32.6	10.9	3.6	282	119.0	39.7	13.2	4.4
233	98.3	32.8	10.9	3.6	283	119.4	39.8	13.3	4.4
234	98.7	32.9	11.0	3.7	284	119.8	39.9	13.3	4.4
235	99.1	33.0	11.0	3.7	285	120.2	40.1	13.4	4.5
236	99.6	33.2	11.1	3.7	286	120.7	40.2	13.4	4.5
237	100.0	33.3	11.1	3.7	287	121.1	40.4	13.5	4.5
238	100.4	33.5	11.2	3.7	288	121.5	40.5	13.5	4.5
239	100.8	33.6	11.2	3.7	289	121.9	40.6	13.5	4.5
240	101.3	33.8	11.3	3.8	290	122.3	40.8	13.6	4.5
241	101.7	33.9	11.3	3.8	291	122.8	40.9	13.6	4.5
242	102.1	34.0	11.3	3.8	292	123.2	41.1	13.7	4.6
243	102.5	34.2	11.4	3.8	293	123.6	41.2	13.7	4.6
244	102.9	34.3	11.4	3.8	294	124.0	41.3	13.8	4.6
245	103.4	34.5	11.5	3.8	295	124.5	41.5	13.8	4.6
246	103.8	34.6	11.5	3.8	296	124.9	41.6	13.9	4.6
247	104.2	34.7	11.6	3.9	297	125.3	41.8	13.9	4.6
248	104.6	34.9	11.6	3.9	298	125.7	41.9	14.0	4.7
249	105.0	35.0	11.7	3.9	299	126.1	42.0	14.0	4.7
250	105.5	35.2	11.7	3.9	300	126.6	42.2	14.1	4.7

TABLE 89 (Continued)

Population	27 Class	9 Class	3 Class	1 Class	Population	27 Class	9 Class	3 Class	1 Class
301	127.0	42.3	14.1	4.7	351	148.1	49.4	16.5	5.5
302	127.4	42.5	14.2	4.7	352	148.5	49.5	16.5	5.5
303	127.8	42.6	14.2	4.7	353	148.9	49.6	16.5	5.5
304	128.3	42.8	14.3	4.8	354	149.3	49.8	16.6	5.5
305	128.7	42.9	14.3	4.8	355	149.8	49.9	16.6	5.5
306	129.1	43.0	14.3	4.8	356	150.2	50.1	16.7	5.6
307	129.5	43.2	14.4	4.8	357	150.6	50.2	16.7	5.6
308	129.9	43.3	14.4	4.8	358	151.0	50.3	16.8	5.6
309	130.4	43.5	14.5	4.8	359	151.5	50.5	16.8	5.6
310	130.8	43.6	14.5	4.8	360	151.9	50.6	16.9	5.6
311	131.2	43.7	14.6	4.9	361	152.3	50.8	16.9	5.6
312	131.6	43.9	14.6	4.9	362	152.7	50.9	17.0	5.7
313	132.0	44.0	14.7	4.9	363	153.1	51.0	17.0	5.7
314	132.5	44.2	14.7	4.9	364	153.6	51.2	17.1	5.7
315	132.9	44.3	14.8	4.9	365	154.0	51.3	17.1	5.7
316	133.3	44.4	14.8	4.9	366	154.4	51.5	17.2	5.7
317	133.7	44.6	14.9	5.0	367	154.8	51.6	17.2	5.7
318	134.2	44.7	14.9	5.0	368	155.3	51.8	17.3	5.8
319	134.6	44.9	15.0	5.0	369	155.7	51.9	17.3	5.8
320	135.0	45.0	15.0	5.0	370	156.1	52.0	17.3	5.8
321	135.4	45.1	15.0	5.0	371	156.5	52.2	17.4	5.8
322	135.8	45.3	15.1	5.0	372	156.9	52.3	17.4	5.8
323	136.3	45.4	15.1	5.0	373	157.4	52.5	17.5	5.8
324	136.7	45.6	15.2	5.1	374	157.8	52.6	17.5	5.8
325	137.1	45.7	15.2	5.1	375	158.2	52.7	17.6	5.9
326	137.5	45.8	15.3	5.1	376	158.6	52.9	17.6	5.9
327	138.0	46.0	15.3	5.1	377	159.0	53.0	17.7	5.9
328	138.4	46.1	15.4	5.1	378	159.5	53.2	17.7	5.9
329	138.8	46.3	15.4	5.1	379	159.9	53.3	17.8	5.9
330	139.2	46.4	15.5	5.2	380	160.3	53.4	17.8	5.9
331	139.6	46.5	15.5	5.2	381	160.7	53.6	17.9	6.0
332	140.1	46.7	15.6	5.2	382	161.2	53.7	17.9	6.0
333	140.5	46.8	15.6	5.2	383	161.6	53.9	18.0	6.0
334	140.9	47.0	15.7	5.2	384	162.0	54.0	18.0	6.0
335	141.3	47.1	15.7	5.2	385	162.4	54.1	18.0	6.0
336	141.8	47.3	15.8	5.3	386	162.8	54.3	18.1	6.0
337	142.2	47.4	15.8	5.3	387	163.3	54.4	18.1	6.0
338	142.6	47.5	15.8	5.3	388	163.7	54.6	18.2	6.1
339	143.0	47.7	15.9	5.3	389	164.1	54.7	18.2	6.1
340	143.4	47.8	15.9	5.3	390	164.5	54.8	18.3	6.1
341	143.9	48.0	16.0	5.3	391	165.0	55.0	18.3	6.1
342	144.3	48.1	16.0	5.3	392	165.4	55.1	18.4	6.1
343	144.7	48.2	16.1	5.4	393	165.8	55.3	18.4	6.1
344	145.1	48.4	16.1	5.4	394	166.2	55.4	18.5	6.2
345	145.5	48.5	16.2	5.4	395	166.6	55.5	18.5	6.2
346	146.0	48.7	16.2	5.4	396	167.1	55.7	18.6	6.2
347	146.4	48.8	16.3	5.4	397	167.5	55.8	18.6	6.2
348	146.8	48.9	16.3	5.4	398	167.9	56.0	18.7	6.2
349	147.2	49.1	16.4	5.5	399	168.3	56.1	18.7	6.2
350	147.7	49.2	16.4	5.5	400	168.8	56.3	18.8	6.3

TABLE 89 (Continued)

Population	27 Class	9 Class	3 Class	1 Class	Population	27 Class	9 Class	3 Class	1 Class
401	169.2	56.4	18.8	6.3	451	190.3	63.4	21.1	7.0
402	169.6	56.5	18.8	6.3	452	190.7	63.6	21.2	7.1
403	170.0	56.7	18.9	6.3	453	191.1	63.7	21.2	7.1
404	170.4	56.8	18.9	6.3	454	191.5	63.8	21.3	7.1
405	170.9	57.0	19.0	6.3	455	192.0	64.0	21.3	7.1
406	171.3	57.1	19.0	6.3	456	192.4	64.1	21.4	7.1
407	171.7	57.2	19.1	6.4	457	192.8	64.3	21.4	7.1
408	172.1	57.4	19.1	6.4	458	193.2	64.4	21.5	7.2
409	172.5	57.5	19.2	6.4	459	193.6	64.5	21.5	7.2
410	173.0	57.7	19.2	6.4	460	194.1	64.7	21.6	7.2
411	173.4	57.8	19.3	6.4	461	194.5	64.8	21.6	7.2
412	173.8	57.9	19.3	6.4	462	194.9	65.0	21.7	7.2
413	174.2	58.1	19.4	6.5	463	195.3	65.1	21.7	7.2
414	174.7	58.2	19.4	6.5	464	195.8	65.3	21.8	7.3
415	175.1	58.4	19.5	6.5	465	196.2	65.4	21.8	7.3
416	175.5	58.5	19.5	6.5	466	196.6	65.5	21.8	7.3
417	175.9	58.6	19.5	6.5	467	197.0	65.7	21.9	7.3
418	176.3	58.8	19.6	6.5	468	197.4	65.8	21.9	7.3
419	176.8	58.9	19.6	6.5	469	197.9	66.0	22.0	7.3
420	177.2	59.1	19.7	6.6	470	198.3	66.1	22.0	7.3
421	177.6	59.2	19.7	6.6	471	198.7	66.2	22.1	7.4
422	178.0	59.3	19.8	6.6	472	199.1	66.4	22.1	7.4
423	178.5	59.5	19.8	6.6	473	199.5	66.5	22.2	7.4
424	178.9	59.6	19.9	6.6	474	200.0	66.7	22.2	7.4
425	179.3	59.8	19.9	6.6	475	200.4	66.8	22.3	7.4
426	179.7	59.9	20.0	6.7	476	200.8	66.9	22.3	7.4
427	180.1	60.0	20.0	6.7	477	201.2	67.1	22.4	7.5
428	180.6	60.2	20.1	6.7	478	201.7	67.2	22.4	7.5
429	181.0	60.3	20.1	6.7	479	202.1	67.4	22.5	7.5
430	181.4	60.5	20.2	6.7	480	202.5	67.5	22.5	7.5
431	181.8	60.6	20.2	6.7	481	202.9	67.6	22.5	7.5
432	182.3	60.8	20.3	6.8	482	203.3	67.8	22.6	7.5
433	182.7	60.9	20.3	6.8	483	203.8	67.9	22.6	7.5
434	183.1	61.0	20.3	6.8	484	204.2	68.1	22.7	7.6
435	183.5	61.2	20.4	6.8	485	204.6	68.2	22.7	7.6
436	183.9	61.3	20.4	6.8	486	205.0	68.3	22.8	7.6
437	184.4	61.5	20.5	6.8	487	205.5	68.5	22.8	7.6
438	184.8	61.6	20.5	6.8	488	205.9	68.6	22.9	7.6
439	185.2	61.7	20.6	6.9	489	206.3	68.8	22.9	7.6
440	185.6	61.9	20.6	6.9	490	206.7	68.9	23.0	7.7
441	186.0	62.0	20.7	6.9	491	207.1	69.0	23.0	7.7
442	186.5	62.2	20.7	6.9	492	207.6	69.2	23.1	7.7
443	186.9	62.3	20.8	6.9	493	208.0	69.3	23.1	7.7
444	187.3	62.4	20.8	6.9	494	208.4	69.5	23.2	7.7
445	187.7	62.6	20.9	7.0	495	208.8	69.6	23.2	7.7
446	188.2	62.7	20.9	7.0	496	209.3	69.8	23.3	7.8
447	188.6	62.9	21.0	7.0	497	209.7	69.9	23.3	7.8
448	189.0	63.0	21.0	7.0	498	210.1	70.0	23.3	7.8
449	189.4	63.1	21.0	7.0	499	210.5	70.2	23.4	7.8
450	189.8	63.3	21.1	7.0	500	210.9	70.3	23.4	7.8

TABLE 90

Probable errors of the 3 and the 1 classes of the F_2 Monohybrid Mendelian ratio 3:1 for populations of from 4 to 500 calculated by the formula $Ep = 0.67449\sqrt{npq}$

No.	0	1	2	3	4	5	6	7	8	9
0	....	....	....	....	0.58	0.65	0.72	0.77	0.83	0.88
1	0.92	0.97	1.01	1.05	1.09	1.13	1.17	1.20	1.24	1.27
2	1.31	1.34	1.37	1.40	1.43	1.46	1.49	1.52	1.55	1.57
3	1.60	1.63	1.65	1.68	1.70	1.73	1.75	1.78	1.80	1.82
4	1.85	1.87	1.89	1.92	1.94	1.96	1.98	2.00	2.02	2.04
5	2.07	2.09	2.11	2.13	2.15	2.17	2.19	2.21	2.22	2.24
6	2.26	2.28	2.30	2.32	2.34	2.36	2.37	2.39	2.41	2.43
7	2.44	2.46	2.48	2.50	2.51	2.53	2.55	2.56	2.58	2.60
8	2.61	2.63	2.65	2.66	2.68	2.69	2.71	2.72	2.74	2.76
9	2.77	2.79	2.80	2.82	2.83	2.85	2.86	2.88	2.89	2.91
10	2.92	2.94	2.95	2.96	2.98	2.99	3.01	3.02	3.04	3.05
11	3.06	3.08	3.09	3.11	3.12	3.13	3.15	3.16	3.17	3.19
12	3.20	3.21	3.23	3.24	3.25	3.27	3.28	3.29	3.30	3.32
13	3.33	3.34	3.36	3.37	3.38	3.39	3.41	3.42	3.43	3.44
14	3.46	3.47	3.48	3.49	3.51	3.52	3.53	3.54	3.55	3.57
15	3.58	3.59	3.60	3.61	3.63	3.64	3.65	3.66	3.67	3.68
16	3.69	3.71	3.72	3.73	3.74	3.75	3.76	3.77	3.79	3.80
17	3.81	3.82	3.83	3.84	3.85	3.86	3.88	3.89	3.90	3.91
18	3.92	3.93	3.94	3.95	3.96	3.97	3.98	3.99	4.00	4.02
19	4.03	4.04	4.05	4.06	4.07	4.08	4.09	4.10	4.11	4.12
20	4.13	4.14	4.15	4.16	4.17	4.18	4.19	4.20	4.21	4.22
21	4.23	4.24	4.25	4.26	4.27	4.28	4.29	4.30	4.31	4.32
22	4.33	4.34	4.35	4.36	4.37	4.38	4.39	4.40	4.41	4.42
23	4.43	4.44	4.45	4.46	4.47	4.48	4.49	4.50	4.51	4.52
24	4.52	4.53	4.54	4.55	4.56	4.57	4.58	4.59	4.60	4.61
25	4.62	4.63	4.64	4.65	4.66	4.66	4.67	4.68	4.69	4.70
26	4.71	4.72	4.73	4.74	4.75	4.75	4.76	4.77	4.78	4.79
27	4.80	4.81	4.82	4.83	4.84	4.84	4.85	4.86	4.87	4.88
28	4.89	4.90	4.91	4.91	4.92	4.93	4.94	4.95	4.96	4.97
29	4.97	4.98	4.99	5.00	5.01	5.02	5.03	5.03	5.04	5.05
30	5.06	5.07	5.08	5.08	5.09	5.10	5.11	5.12	5.13	5.13
31	5.14	5.15	5.16	5.17	5.18	5.18	5.19	5.20	5.21	5.22
32	5.23	5.23	5.24	5.25	5.26	5.27	5.27	5.28	5.29	5.30
33	5.31	5.31	5.32	5.33	5.34	5.35	5.35	5.36	5.37	5.38
34	5.39	5.39	5.40	5.41	5.42	5.43	5.43	5.44	5.45	5.46
35	5.46	5.47	5.48	5.49	5.50	5.50	5.51	5.52	5.53	5.53
36	5.54	5.55	5.56	5.57	5.57	5.58	5.59	5.60	5.60	5.61
37	5.62	5.63	5.63	5.64	5.65	5.66	5.66	5.67	5.68	5.69
38	5.69	5.70	5.71	5.72	5.72	5.73	5.74	5.75	5.75	5.76
39	5.77	5.78	5.78	5.79	5.80	5.81	5.81	5.82	5.83	5.83
40	5.84	5.85	5.86	5.86	5.87	5.88	5.89	5.89	5.90	5.91
41	5.91	5.92	5.93	5.94	5.94	5.95	5.96	5.96	5.97	5.98
42	5.99	5.99	6.00	6.01	6.01	6.02	6.03	6.04	6.04	6.05
43	6.06	6.06	6.07	6.08	6.09	6.09	6.10	6.11	6.11	6.12
44	6.13	6.13	6.14	6.15	6.15	6.16	6.17	6.18	6.18	6.19
45	6.20	6.20	6.21	6.22	6.22	6.23	6.24	6.24	6.25	6.26
46	6.26	6.27	6.28	6.29	6.29	6.30	6.31	6.31	6.32	6.33
47	6.33	6.34	6.35	6.35	6.36	6.37	6.37	6.38	6.39	6.39
48	6.40	6.41	6.41	6.42	6.43	6.43	6.44	6.45	6.45	6.46
49	6.47	6.47	6.48	6.49	6.49	6.50	6.51	6.51	6.52	6.52
50	6.53									

TABLE 91

Probable errors of the 9 class of the F_2 Dihybrid Mendelian ratio 9:3:3:1 for populations of from 16 to 500 calculated by the formula $Ep = 0.67449\sqrt{npq}$

No.	0	1	2	3	4	5	6	7	8	9
1	....	....	....	....	....	....	1.34	1.38	1.42	1.46
2	1.50	1.53	1.57	1.61	1.64	1.67	1.71	1.74	1.77	1.80
3	1.83	1.86	1.89	1.92	1.95	1.98	2.01	2.04	2.06	2.09
4	2.12	2.14	2.17	2.19	2.22	2.25	2.27	2.29	2.32	2.34
5	2.37	2.39	2.41	2.44	2.46	2.48	2.50	2.53	2.55	2.57
6	2.59	2.61	2.64	2.66	2.68	2.70	2.72	2.74	2.76	2.78
7	2.80	2.82	2.84	2.86	2.88	2.90	2.92	2.94	2.96	2.97
8	2.99	3.01	3.03	3.05	3.07	3.09	3.10	3.12	3.14	3.16
9	3.17	3.19	3.21	3.23	3.24	3.26	3.28	3.30	3.31	3.33
10	3.35	3.36	3.38	3.40	3.41	3.43	3.45	3.46	3.48	3.49
11	3.51	3.53	3.54	3.56	3.57	3.59	3.60	3.62	3.64	3.65
12	3.67	3.68	3.70	3.71	3.73	3.74	3.76	3.77	3.79	3.80
13	3.82	3.83	3.84	3.86	3.87	3.89	3.90	3.92	3.93	3.95
14	3.96	3.97	3.99	4.00	4.02	4.03	4.04	4.06	4.07	4.08
15	4.10	4.11	4.13	4.14	4.15	4.17	4.18	4.19	4.21	4.22
16	4.23	4.25	4.26	4.27	4.29	4.30	4.31	4.32	4.34	4.35
17	4.36	4.38	4.39	4.40	4.41	4.43	4.44	4.45	4.46	4.48
18	4.49	4.50	4.51	4.53	4.54	4.55	4.56	4.58	4.59	4.60
19	4.61	4.62	4.64	4.65	4.66	4.67	4.68	4.70	4.71	4.72
20	4.73	4.74	4.76	4.77	4.78	4.79	4.80	4.81	4.83	4.84
21	4.85	4.86	4.87	4.88	4.90	4.91	4.92	4.93	4.94	4.95
22	4.96	4.97	4.99	5.00	5.01	5.02	5.03	5.04	5.05	5.06
23	5.07	5.09	5.10	5.11	5.12	5.13	5.14	5.15	5.16	5.17
24	5.18	5.19	5.21	5.22	5.23	5.24	5.25	5.26	5.27	5.28
25	5.29	5.30	5.31	5.32	5.33	5.34	5.35	5.36	5.37	5.39
26	5.40	5.41	5.42	5.43	5.44	5.45	5.46	5.47	5.48	5.49
27	5.50	5.51	5.52	5.53	5.54	5.55	5.56	5.57	5.58	5.59
28	5.60	5.61	5.62	5.63	5.64	5.65	5.66	5.67	5.68	5.69
29	5.70	5.71	5.72	5.73	5.74	5.75	5.76	5.77	5.78	5.79
30	5.80	5.81	5.82	5.82	5.83	5.84	5.85	5.86	5.87	5.88
31	5.89	5.90	5.91	5.92	5.93	5.94	5.95	5.96	5.97	5.98
32	5.99	6.00	6.01	6.01	6.02	6.03	6.04	6.05	6.06	6.07
33	6.08	6.09	6.10	6.11	6.12	6.13	6.13	6.14	6.15	6.16
34	6.17	6.18	6.19	6.20	6.21	6.22	6.22	6.23	6.24	6.25
35	6.26	6.27	6.28	6.29	6.30	6.31	6.31	6.32	6.33	6.34
36	6.35	6.36	6.37	6.38	6.39	6.39	6.40	6.41	6.42	6.43
37	6.44	6.45	6.45	6.46	6.47	6.48	6.49	6.50	6.51	6.51
38	6.52	6.53	6.54	6.55	6.56	6.57	6.57	6.58	6.59	6.60
39	6.61	6.62	6.63	6.63	6.64	6.65	6.66	6.67	6.68	6.68
40	6.69	6.70	6.71	6.72	6.73	6.75	6.74	6.75	6.76	6.77
41	6.78	6.79	6.79	6.80	6.81	6.82	6.83	6.83	6.84	6.85
42	6.86	6.87	6.87	6.88	6.89	6.90	6.91	6.91	6.92	6.93
43	6.94	6.95	6.96	6.96	6.97	6.98	6.99	7.00	7.00	7.01
44	7.02	7.03	7.04	7.04	7.05	7.06	7.07	7.08	7.08	7.09
45	7.10	7.11	7.12	7.12	7.13	7.14	7.14	7.15	7.16	7.17
46	7.18	7.18	7.19	7.20	7.21	7.22	7.22	7.23	7.24	7.25
47	7.25	7.26	7.27	7.28	7.29	7.29	7.30	7.31	7.32	7.33
48	7.33	7.34	7.35	7.35	7.36	7.37	7.38	7.39	7.39	7.40
49	7.41	7.41	7.42	7.43	7.44	7.45	7.45	7.46	7.47	7.47
50	7.48									

TABLE 92

Probable errors of the 3 class of the F_2 Dihybrid Mendelian ratio 9:3:3:1 for populations of from 16 to 500 calculated by the formula $Ep = 0.67449\sqrt{npq}$

No.	0	1	2	3	4	5	6	7	8	9
1	...	...	...	...	...	...	1.05	1.09	1.12	1.15
2	1.18	1.21	1.24	1.26	1.29	1.32	1.34	1.37	1.39	1.42
3	1.44	1.47	1.49	1.51	1.54	1.56	1.58	1.60	1.62	1.64
4	1.67	1.69	1.71	1.73	1.75	1.77	1.79	1.81	1.82	1.84
5	1.86	1.88	1.90	1.92	1.93	1.95	1.97	1.99	2.01	2.02
6	2.04	2.06	2.07	2.09	2.11	2.12	2.14	2.16	2.17	2.19
7	2.20	2.22	2.23	2.25	2.27	2.28	2.30	2.31	2.33	2.34
8	2.36	2.37	2.38	2.40	2.41	2.43	2.44	2.46	2.47	2.48
9	2.50	2.51	2.53	2.54	2.55	2.57	2.58	2.59	2.61	2.62
10	2.63	2.65	2.66	2.67	2.69	2.70	2.71	2.72	2.74	2.75
11	2.76	2.77	2.79	2.80	2.81	2.82	2.84	2.85	2.86	2.87
12	2.88	2.90	2.91	2.92	2.93	2.94	2.96	2.97	2.98	2.99
13	3.00	3.01	3.02	3.04	3.05	3.06	3.07	3.08	3.09	3.10
14	3.12	3.13	3.14	3.15	3.16	3.17	3.18	3.19	3.20	3.21
15	3.22	3.24	3.25	3.26	3.27	3.28	3.29	3.30	3.31	3.32
16	3.33	3.34	3.35	3.36	3.37	3.38	3.39	3.40	3.41	3.42
17	3.43	3.44	3.45	3.46	3.47	3.48	3.49	3.50	3.51	3.52
18	3.53	3.54	3.55	3.56	3.57	3.58	3.59	3.60	3.61	3.62
19	3.63	3.64	3.65	3.66	3.67	3.68	3.69	3.70	3.70	3.71
20	3.72	3.73	3.74	3.75	3.76	3.77	3.78	3.79	3.80	3.81
21	3.82	3.82	3.83	3.84	3.85	3.86	3.87	3.88	3.89	3.90
22	3.91	3.91	3.92	3.93	3.94	3.95	3.96	3.97	3.98	3.98
23	3.99	4.00	4.01	4.02	4.03	4.04	4.04	4.05	4.06	4.07
24	4.08	4.09	4.10	4.10	4.11	4.12	4.13	4.14	4.15	4.15
25	4.16	4.17	4.18	4.19	4.20	4.20	4.21	4.22	4.23	4.24
26	4.25	4.25	4.26	4.27	4.28	4.29	4.29	4.30	4.31	4.32
27	4.33	4.33	4.34	4.35	4.36	4.37	4.37	4.38	4.39	4.40
28	4.41	4.41	4.42	4.43	4.44	4.44	4.45	4.46	4.47	4.48
29	4.48	4.49	4.50	4.51	4.51	4.52	4.53	4.54	4.55	4.55
30	4.56	4.57	4.58	4.58	4.59	4.60	4.61	4.61	4.62	4.63
31	4.64	4.64	4.65	4.66	4.67	4.67	4.68	4.69	4.70	4.70
32	4.71	4.72	4.72	4.73	4.74	4.75	4.75	4.76	4.77	4.78
33	4.78	4.79	4.80	4.80	4.81	4.82	4.83	4.83	4.84	4.85
34	4.85	4.86	4.87	4.88	4.88	4.89	4.90	4.90	4.91	4.92
35	4.93	4.93	4.94	4.95	4.95	4.96	4.97	4.97	4.98	4.99
36	5.00	5.00	5.01	5.02	5.02	5.03	5.04	5.04	5.05	5.06
37	5.06	5.07	5.08	5.08	5.09	5.10	5.11	5.11	5.12	5.13
38	5.13	5.14	5.15	5.15	5.16	5.17	5.17	5.18	5.19	5.19
39	5.20	5.21	5.21	5.22	5.23	5.23	5.24	5.25	5.25	5.26
40	5.27	5.27	5.28	5.29	5.29	5.30	5.31	5.31	5.32	5.33
41	5.33	5.34	5.34	5.35	5.36	5.36	5.37	5.38	5.38	5.39
42	5.40	5.40	5.41	5.41	5.42	5.43	5.43	5.44	5.45	5.45
43	5.46	5.47	5.47	5.48	5.48	5.49	5.50	5.50	5.51	5.52
44	5.52	5.53	5.54	5.54	5.55	5.55	5.56	5.57	5.57	5.58
45	5.59	5.59	5.60	5.60	5.61	5.62	5.62	5.63	5.63	5.64
46	5.65	5.65	5.66	5.67	5.67	5.68	5.68	5.69	5.70	5.70
47	5.71	5.71	5.72	5.73	5.73	5.74	5.74	5.75	5.76	5.76
48	5.77	5.77	5.78	5.79	5.79	5.80	5.80	5.81	5.82	5.82
49	5.83	5.83	5.84	5.85	5.85	5.86	5.86	5.87	5.88	5.88
50	5.89									

TABLE 93

Probable errors of the 27 class of the F_2 Trihybrid Mendelian ratio 27:9:9:9:3:3:3:1 for populations of from 64 to 500 calculated by the formula $Ep=0.67449\sqrt{npq}$

No.	0	1	2	3	4	5	6	7	8	9
6	...	...	...	...	2.67	2.69	2.71	2.73	2.75	2.77
7	2.79	2.81	2.83	2.85	2.87	2.89	2.90	2.92	2.94	2.96
8	2.98	3.00	3.02	3.04	3.05	3.07	3.09	3.11	3.13	3.14
9	3.16	3.18	3.20	3.21	3.23	3.25	3.26	3.28	3.30	3.32
10	3.33	3.35	3.37	3.38	3.40	3.41	3.43	3.45	3.46	3.48
11	3.49	3.51	3.53	3.54	3.56	3.57	3.59	3.60	3.62	3.63
12	3.65	3.66	3.68	3.69	3.71	3.72	3.74	3.75	3.77	3.78
13	3.80	3.81	3.83	3.84	3.86	3.87	3.88	3.90	3.91	3.93
14	3.94	3.96	3.97	3.98	4.00	4.01	4.03	4.04	4.05	4.07
15	4.08	4.09	4.11	4.12	4.13	4.15	4.16	4.17	4.19	4.20
16	4.21	4.23	4.24	4.25	4.27	4.28	4.29	4.31	4.32	4.33
17	4.34	4.36	4.37	4.38	4.39	4.41	4.42	4.43	4.44	4.46
18	4.47	4.48	4.49	4.51	4.52	4.53	4.54	4.56	4.57	4.58
19	4.59	4.60	4.62	4.63	4.64	4.65	4.66	4.68	4.69	4.70
20	4.71	4.72	4.73	4.75	4.76	4.77	4.78	4.79	4.80	4.82
21	4.83	4.84	4.85	4.86	4.87	4.88	4.90	4.91	4.92	4.93
22	4.94	4.95	4.96	4.97	4.99	5.00	5.01	5.02	5.03	5.04
23	5.05	5.06	5.07	5.08	5.10	5.11	5.12	5.13	5.14	5.15
24	5.16	5.17	5.18	5.19	5.20	5.21	5.23	5.24	5.25	5.26
25	5.27	5.28	5.29	5.30	5.31	5.32	5.33	5.34	5.35	5.36
26	5.37	5.38	5.39	5.40	5.41	5.42	5.43	5.44	5.45	5.46
27	5.47	5.48	5.49	5.50	5.51	5.52	5.53	5.54	5.55	5.56
28	5.57	5.58	5.59	5.60	5.61	5.62	5.63	5.64	5.65	5.66
29	5.67	5.68	5.69	5.70	5.71	5.72	5.73	5.74	5.75	5.76
30	5.77	5.78	5.79	5.80	5.81	5.82	5.83	5.84	5.85	5.86
31	5.87	5.87	5.88	5.89	5.90	5.91	5.92	5.93	5.94	5.95
32	5.96	5.97	5.98	5.99	6.00	6.01	6.02	6.02	6.03	6.04
33	6.05	6.06	6.07	6.08	6.09	6.10	6.11	6.12	6.12	6.13
34	6.14	6.15	6.16	6.17	6.18	6.19	6.20	6.21	6.21	6.22
35	6.23	6.24	6.25	6.26	6.27	6.28	6.29	6.29	6.30	6.31
36	6.32	6.33	6.34	6.35	6.36	6.36	6.37	6.38	6.39	6.40
37	6.41	6.42	6.43	6.43	6.44	6.45	6.46	6.47	6.48	6.49
38	6.49	6.50	6.51	6.52	6.53	6.54	6.55	6.55	6.56	6.57
39	6.58	6.59	6.60	6.60	6.61	6.62	6.63	6.64	6.65	6.65
40	6.66	6.67	6.68	6.69	6.70	6.70	6.71	6.72	6.73	6.74
41	6.75	6.75	6.76	6.77	6.78	6.79	6.79	6.80	6.81	6.82
42	6.83	6.83	6.84	6.85	6.86	6.87	6.87	6.88	6.89	6.90
43	6.91	6.91	6.92	6.93	6.94	6.95	6.96	6.96	6.97	6.98
44	6.99	7.00	7.00	7.01	7.02	7.03	7.04	7.04	7.05	7.06
45	7.07	7.08	7.08	7.09	7.10	7.11	7.11	7.12	7.13	7.14
46	7.14	7.15	7.16	7.17	7.18	7.18	7.19	7.20	7.21	7.22
47	7.22	7.23	7.24	7.25	7.25	7.26	7.27	7.28	7.29	7.29
48	7.30	7.31	7.31	7.32	7.33	7.34	7.35	7.35	7.36	7.37
49	7.37	7.38	7.39	7.40	7.41	7.41	7.42	7.43	7.43	7.44
50	7.45									

TABLE 94

Probable errors of the 9 class of the F_2 Trihybrid Mendelian ratio 27:9:9:9:3:3:3:1 for populations of from 64 to 500 calculated by the formula $Ep=0.67449\sqrt{npq}$

No.	0	1	2	3	4	5	6	7	8	9
6	...	...	...	...	1.88	1.89	1.91	1.92	1.93	1.95
7	1.96	1.98	1.99	2.00	2.02	2.03	2.04	2.06	2.07	2.08
8	2.10	2.11	2.12	2.14	2.15	2.16	2.18	2.19	2.20	2.21
9	2.23	2.24	2.25	2.26	2.27	2.29	2.30	2.31	2.32	2.33
10	2.35	2.36	2.37	2.38	2.39	2.40	2.41	2.43	2.44	2.45
11	2.46	2.47	2.48	2.49	2.50	2.52	2.53	2.54	2.55	2.56
12	2.57	2.58	2.59	2.60	2.61	2.62	2.63	2.64	2.65	2.66
13	2.67	2.68	2.69	2.70	2.71	2.72	2.73	2.75	2.76	2.77
14	2.77	2.78	2.79	2.80	2.81	2.82	2.83	2.84	2.85	2.86
15	2.87	2.88	2.89	2.90	2.91	2.92	2.93	2.94	2.95	2.96
16	2.97	2.98	2.99	2.99	3.00	3.01	3.02	3.03	3.04	3.05
17	3.06	3.07	3.08	3.08	3.09	3.10	3.11	3.12	3.13	3.14
18	3.15	3.16	3.16	3.17	3.18	3.19	3.20	3.21	3.22	3.22
19	3.23	3.24	3.25	3.26	3.27	3.27	3.28	3.29	3.30	3.31
20	3.32	3.33	3.33	3.34	3.35	3.36	3.37	3.37	3.38	3.39
21	3.40	3.41	3.41	3.42	3.43	3.44	3.45	3.45	3.46	3.47
22	3.48	3.49	3.49	3.50	3.51	3.52	3.53	3.53	3.54	3.55
23	3.56	3.56	3.57	3.58	3.59	3.59	3.60	3.61	3.62	3.63
24	3.63	3.64	3.65	3.66	3.66	3.67	3.68	3.69	3.69	3.70
25	3.71	3.72	3.72	3.73	3.74	3.74	3.75	3.76	3.77	3.77
26	3.78	3.79	3.80	3.80	3.81	3.82	3.82	3.83	3.84	3.85
27	3.85	3.86	3.87	3.87	3.88	3.89	3.90	3.90	3.91	3.92
28	3.92	3.93	3.94	3.95	3.95	3.96	3.97	3.97	3.98	3.99
29	3.99	4.00	4.01	4.01	4.02	4.03	4.03	4.04	4.05	4.05
30	4.06	4.07	4.08	4.08	4.09	4.10	4.10	4.11	4.12	4.12
31	4.13	4.14	4.14	4.15	4.16	4.16	4.17	4.17	4.18	4.19
32	4.20	4.20	4.21	4.21	4.22	4.23	4.23	4.24	4.25	4.25
33	4.26	4.27	4.27	4.28	4.29	4.29	4.30	4.31	4.31	4.32
34	4.32	4.33	4.34	4.34	4.35	4.36	4.36	4.37	4.37	4.38
35	4.39	4.39	4.40	4.41	4.41	4.42	4.42	4.43	4.44	4.44
36	4.45	4.46	4.46	4.47	4.47	4.48	4.49	4.49	4.50	4.50
37	4.51	4.52	4.52	4.53	4.54	4.54	4.55	4.55	4.56	4.57
38	4.57	4.58	4.58	4.59	4.60	4.60	4.61	4.61	4.62	4.63
39	4.63	4.64	4.64	4.65	4.65	4.66	4.67	4.67	4.68	4.68
40	4.69	4.70	4.70	4.71	4.71	4.72	4.73	4.73	4.74	4.74
41	4.75	4.75	4.76	4.77	4.77	4.78	4.78	4.79	4.79	4.80
42	4.81	4.81	4.82	4.82	4.83	4.83	4.84	4.85	4.85	4.86
43	4.86	4.87	4.87	4.88	4.89	4.89	4.90	4.90	4.91	4.91
44	4.92	4.92	4.93	4.94	4.94	4.95	4.95	4.96	4.96	4.97
45	4.97	4.98	4.99	4.99	5.00	5.00	5.01	5.01	5.02	5.02
46	5.03	5.04	5.04	5.05	5.05	5.06	5.06	5.07	5.07	5.08
47	5.08	5.09	5.09	5.10	5.11	5.11	5.12	5.12	5.13	5.13
48	5.14	5.14	5.15	5.15	5.16	5.16	5.17	5.18	5.18	5.19
49	5.19	5.20	5.20	5.21	5.21	5.22	5.22	5.23	5.23	5.24
50	5.24									

TABLE 95

Probable errors of the 3 class of the F_2 Trihybrid Mendelian ratio 27:9:9:9:3:3:3:1 for populations of from 64 to 500 calculated by the formula $Ep = 0.67449\sqrt{npq}$

No.	0	1	2	3	4	5	6	7	8	9
6	...	...	...	...	1.14	1.15	1.16	1.17	1.18	1.18
7	1.19	1.20	1.21	1.22	1.23	1.24	1.24	1.25	1.26	1.27
8	1.28	1.28	1.29	1.30	1.31	1.32	1.32	1.33	1.34	1.35
9	1.35	1.36	1.37	1.38	1.38	1.39	1.40	1.40	1.41	1.42
10	1.43	1.43	1.44	1.45	1.45	1.46	1.47	1.47	1.48	1.49
11	1.50	1.50	1.51	1.52	1.52	1.53	1.54	1.54	1.55	1.56
12	1.56	1.57	1.58	1.58	1.59	1.59	1.60	1.61	1.61	1.62
13	1.63	1.63	1.64	1.64	1.65	1.66	1.66	1.67	1.68	1.68
14	1.69	1.69	1.70	1.71	1.71	1.72	1.72	1.73	1.73	1.74
15	1.75	1.75	1.76	1.76	1.77	1.78	1.78	1.79	1.79	1.80
16	1.80	1.81	1.81	1.82	1.83	1.83	1.84	1.84	1.85	1.85
17	1.86	1.86	1.87	1.88	1.88	1.89	1.89	1.90	1.90	1.91
18	1.91	1.92	1.92	1.93	1.93	1.94	1.95	1.95	1.96	1.96
19	1.97	1.97	1.98	1.98	1.99	1.99	2.00	2.00	2.01	2.01
20	2.02	2.02	2.03	2.03	2.04	2.04	2.05	2.05	2.06	2.06
21	2.07	2.07	2.08	2.08	2.09	2.09	2.10	2.10	2.11	2.11
22	2.12	2.12	2.12	2.13	2.13	2.14	2.14	2.15	2.15	2.16
23	2.16	2.17	2.17	2.18	2.18	2.19	2.19	2.20	2.20	2.20
24	2.21	2.21	2.22	2.22	2.23	2.23	2.24	2.24	2.25	2.25
25	2.25	2.26	2.26	2.27	2.27	2.28	2.28	2.29	2.29	2.30
26	2.30	2.30	2.31	2.31	2.32	2.32	2.33	2.33	2.33	2.34
27	2.34	2.35	2.35	2.36	2.36	2.36	2.37	2.37	2.38	2.38
28	2.39	2.39	2.39	2.40	2.40	2.41	2.41	2.42	2.42	2.42
29	2.43	2.43	2.44	2.44	2.44	2.45	2.45	2.46	2.46	2.47
30	2.47	2.47	2.48	2.48	2.49	2.49	2.49	2.50	2.50	2.51
31	2.51	2.52	2.52	2.52	2.53	2.53	2.53	2.54	2.54	2.55
32	2.55	2.55	2.56	2.56	2.57	2.57	2.57	2.58	2.58	2.59
33	2.59	2.59	2.60	2.60	2.61	2.61	2.61	2.62	2.62	2.63
34	2.63	2.63	2.64	2.64	2.64	2.65	2.65	2.66	2.66	2.66
35	2.67	2.67	2.68	2.68	2.68	2.69	2.69	2.69	2.70	2.70
36	2.71	2.71	2.71	2.72	2.72	2.72	2.73	2.73	2.74	2.74
37	2.74	2.75	2.75	2.75	2.76	2.76	2.77	2.77	2.77	2.78
38	2.78	2.78	2.79	2.79	2.79	2.80	2.80	2.81	2.81	2.81
39	2.82	2.82	2.82	2.83	2.83	2.83	2.84	2.84	2.84	2.85
40	2.85	2.86	2.86	2.86	2.87	2.87	2.87	2.88	2.88	2.88
41	2.89	2.89	2.89	2.90	2.90	2.90	2.91	2.91	2.91	2.92
42	2.92	2.93	2.93	2.93	2.94	2.94	2.94	2.95	2.95	2.95
43	2.96	2.96	2.96	2.97	2.97	2.97	2.98	2.98	2.98	2.99
44	2.99	2.99	3.00	3.00	3.00	3.01	3.01	3.01	3.02	3.02
45	3.02	3.03	3.03	3.04	3.04	3.04	3.05	3.05	3.05	3.05
46	3.06	3.06	3.06	3.07	3.07	3.07	3.08	3.08	3.08	3.09
47	3.09	3.09	3.10	3.10	3.10	3.11	3.11	3.11	3.12	3.12
48	3.12	3.13	3.13	3.13	3.14	3.14	3.14	3.15	3.15	3.15
49	3.16	3.16	3.16	3.17	3.17	3.17	3.18	3.18	3.18	3.19
50	3.19									

Description of Colored Plates

Plate 1. 1, 2, 3. Parents and F_1 of Turkey Red X Harvest King wheat crosses. 1. Typical Turkey Red head. 2. Type of F_1 heads. Notice the tip beards and red color. 3. Type of Harvest King head.

4, 5, 6. Parents and F_1 of Harvest King X Fultz Mediterranean wheat crosses. The Fultz Mediterranean is velvet chaffed. 4. Typical Harvest King head. 5. F_1 head. Notice the red color and the velvet chaff. 6. Typical Fultz Mediterranean head of the velvet chaff type.

7, 8, 9. Parents and F_1 of the Black Winter Emmer X Fultz Mediterranean wheat crosses. 7. Typical Black Winter Emmer head. 8. F_1 head. Notice that aside from the beards the Emmer characters are predominant. 9. Typical Fultz Mediterranean head of the smooth chaff type.

Plate 2. Types of F_2 heads secured from crosses of Harvest King X Turkey Red wheat. 1. Beardless white chaff head of the Turkey type as regards shape. 2. Same of the Harvest King type of shape. 3. A white, bearded, typical Turkey head. 4. A white, bearded head of Harvest King shape.

Plate 3. Types of F_2 heads secured from crosses of Harvest King X Turkey Red wheat. 1. A red beardless head showing Turkey shape. 2. A typical Harvest King head. 3. A typical Turkey Red head but with red chaff. 4. A typical Harvest King head but with beards. The typical variety shapes are inherited but do not follow any simple law of inheritance.

Plate 4. Types of F_2 heads secured in the progeny of Harvest King X Fultz Mediterranean (velvet chaff) wheat crosses. 1. A red and velvet chaff head of the Harvest King shape. 2. The same but of Fultz Mediterranean shape. 3. A typical Harvest King head. 4. A red and smooth chaff head of Fultz Mediterranean shape. 5. A white and velvet chaff head of the Harvest King type. 6. The same but of Fultz Mediterranean shape. 7. A smooth, white chaff head of Harvest King shape. 8. The same but of Fultz Mediterranean shape.

Plate 5. Types of heads secured in the F_2 progeny of Black

Winter Emmer X Fultz Mediterranean wheat crosses. Notice the diversity of characters.

Plate 6. Types of heads secured in the F_2 progeny of Black Winter Emmer X Fultz Mediterranean wheat crosses. Crosses between such radically different wheats give rise to a multitude of forms most of which are self-limited thru infertility or by their inability to compete with the more stable forms in the struggle for existence.

Plate 7. 1, 2, 3. Parents and F_1 of Black Hulled X Beardless barley crosses. 1. Typical Black Hulled barley head. 2. Type of F_1 heads. Hoods, 2-row, and black color are dominant characters. This is a trihybrid cross. 3. Typical Beardless barley head.

4, 5, 6. Parents and F_1 of California X Black Hulled barley crosses. 4. Typical California head. 5. F_1 head. The 2-row and black hull characters are dominant. This is an example of a dihybrid cross. 6. A typical Black Hulled barley head.

Plate 8. Heads of F_2 plants secured from California X Black Hulled barley crosses. 1. 2-row, black hulled head. 2. 6-row, black hulled head. 3. 2-row, white hulled head. 4. 6-row, white hulled head.

Plate 9. Heads of F_2 plants secured from Black Hulled X Beardless barley crosses. Eight visibly different sorts occurred, each one of which was fixed by selecting a large number of F_2 plants and planting the grain from each plant separately. 1. 2-row, black, hooded. 2. 6-row, black, hooded. 3. 2-row, black, bearded. 4. 2-row, white, hooded. 5. 6-row, black, bearded. 6. 6-row, white, hooded. 7. 2-row, white, bearded. 8. 6-row, white, bearded.

PLATE I.

PLATE II.

1 2 3 4 — PRESTON

PLATE III.

1 2 3 4

PLATE IV.

PLATE V.

1 2 3 4 5 6 7 8

PLATE VI.

PLATE VII.

PLATE VIII.

1 2 3 4

PLATE IX.

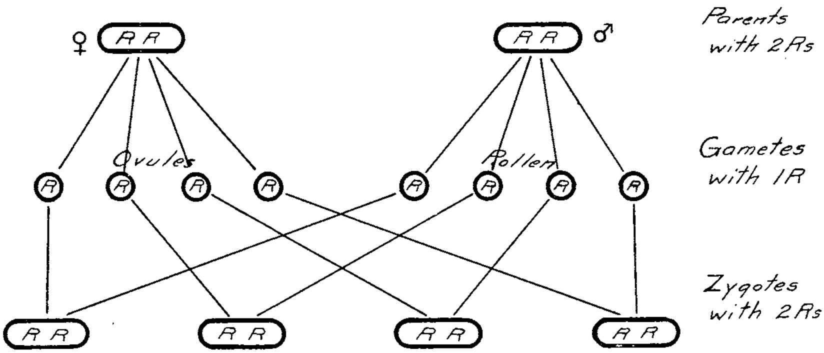

Fig. 1.—Diagram showing inheritance of factors for red chaff according to the factorial hypothesis. Each parent contains two R factors. Reduction takes place during maturation so that each gamete contains one R factor. The original number, or two, is restored in fertilization but each parent has contributed one R.

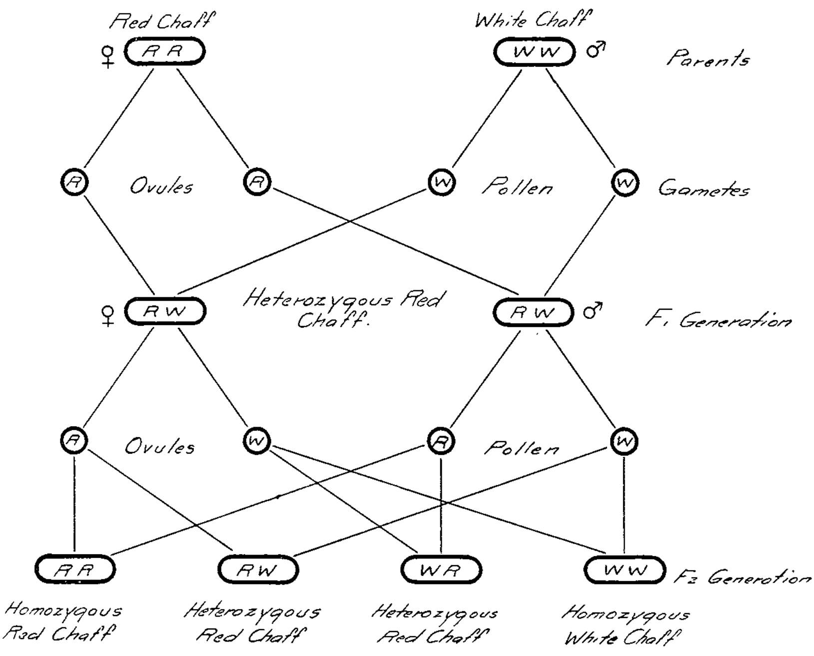

Fig. 2.—Diagram showing inheritance of factors when a wheat with red chaff is crossed with another having white chaff. Each parent contributes one factor to the F_1 plants and thus, the RW combination arises. The RW, F_1 plants then give rise to two sorts of gametes, one part containing only an R factor and the other only a W factor. Since the R and W gametes are supposed to exist in about equal numbers, there are four equally possible combinations that may occur when F_1 plants either are selfed or are crossed with one another.

Fig. 3.—Parents and F_1 of cross 9, Fultz Mediterranean X Black Winter Emmer. (Left) Type of Fultz Mediterranean head. (Center) Head from F_1 plant, 9-1. Notice the short beards at the tip of the head. Excepting for the absence of beards, the head has more of the Emmer characteristics than it has of common wheat. (Right) Typical Emmer head.

Fig. 4.—Parents and F_1 of cross 13, Harvest King X Turkey Red. (Left) Typical Harvest King head. (Center) Head from the F_1 plant, 13-3. Notice the short beards and the spindle shape. (Right) Typical Turkey Red head.

Fig. 5.—Parents and F_1 of cross 9, Fultz Mediterranean X Black Winter Emmer. This is a side view of the same heads shown in Fig. 3 Notice the narrow spikelets of the Emmer.

Fig. 6.—Parents and F_1 of cross 19, Turkey Red X Harvest King. This is a reciprocal cross of No. 13 shown in Fig. 4. The results in the F_1 and F_2 generation were very much the same for both crosses.

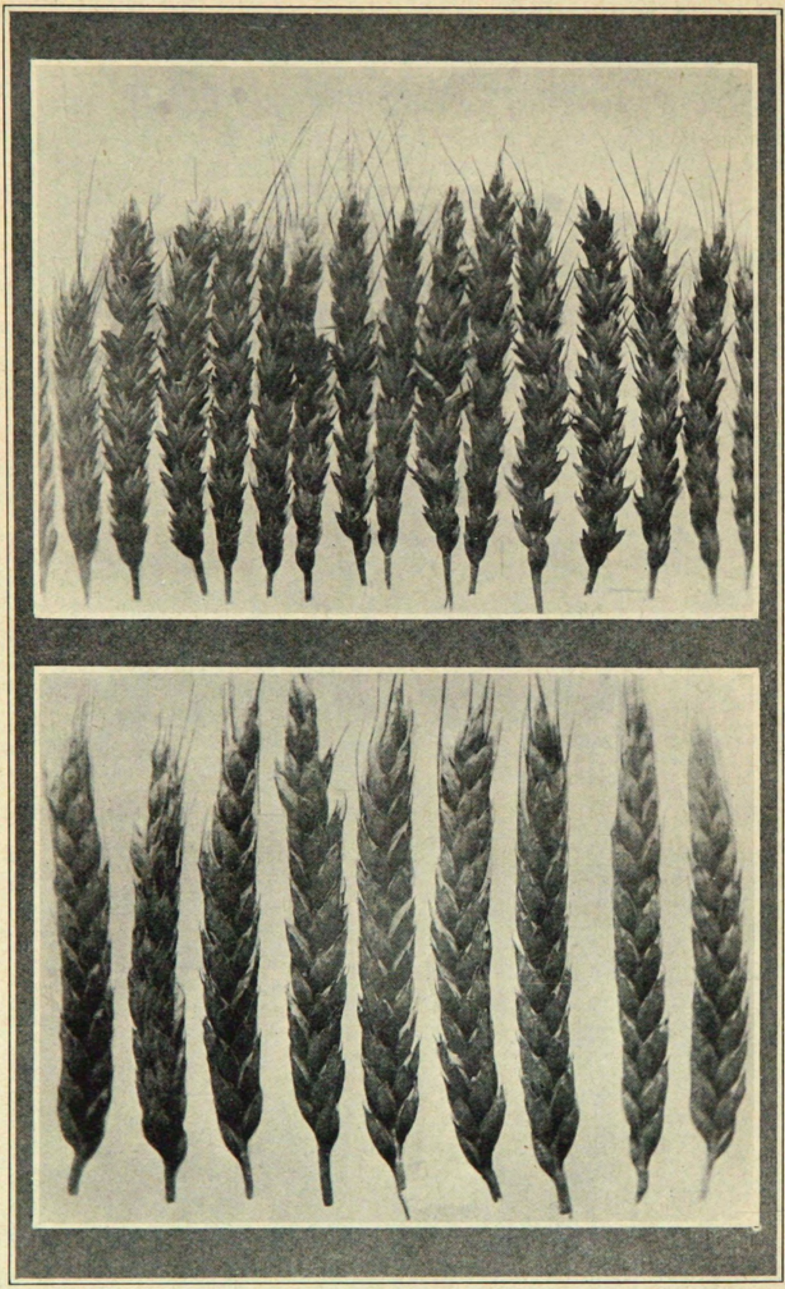

Fig. 7.—Above: The heads from F_1 plant, 13-3, the result of a cross between Harvest King and Turkey Red. Notice the short tip beards. Below: The heads from F_1 plant 9-5, the result of a cross between Fultz Mediterranean and Black Winter Emmer. Notice that the Emmer characteristics are predominant, also the short tip beards. The keeled glumes of the Emmer are prominent.

Fig. 8.—Grains from cross 9, Fultz Mediterranean X Black Winter Emmer. (Left) Typical Fultz Mediterranean grains, short and plump. (Right) Typical Emmer grains rather long and slender. (Center) Grains from F_1 plant. 9-1. The grains are somewhat intermediate in appearance. Many are wrinkled or shriveled, a very common occurrence in the grain of F_1 plants. Many are infertile.

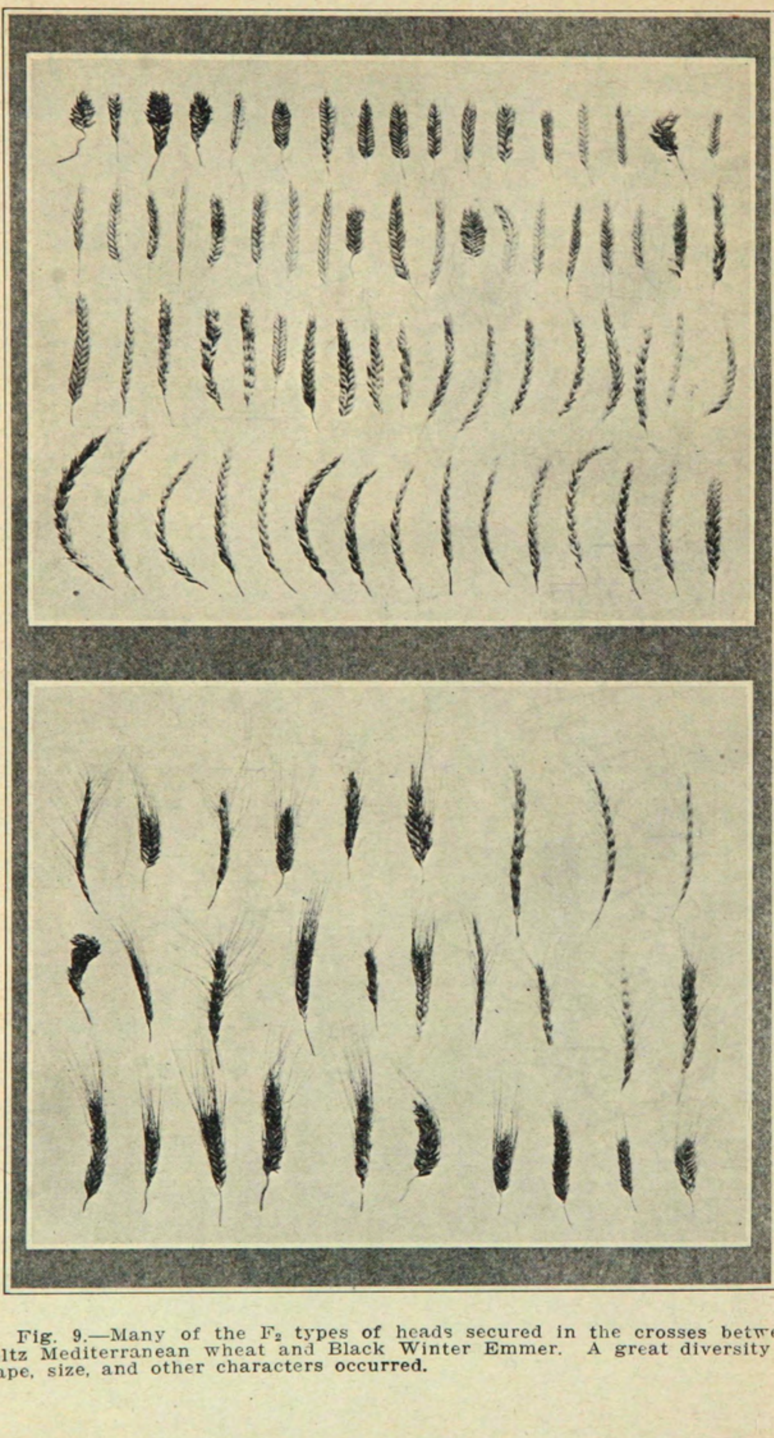

Fig. 9.—Many of the F_2 types of heads secured in the crosses between Fultz Mediterranean wheat and Black Winter Emmer. A great diversity of shape, size, and other characters occurred.

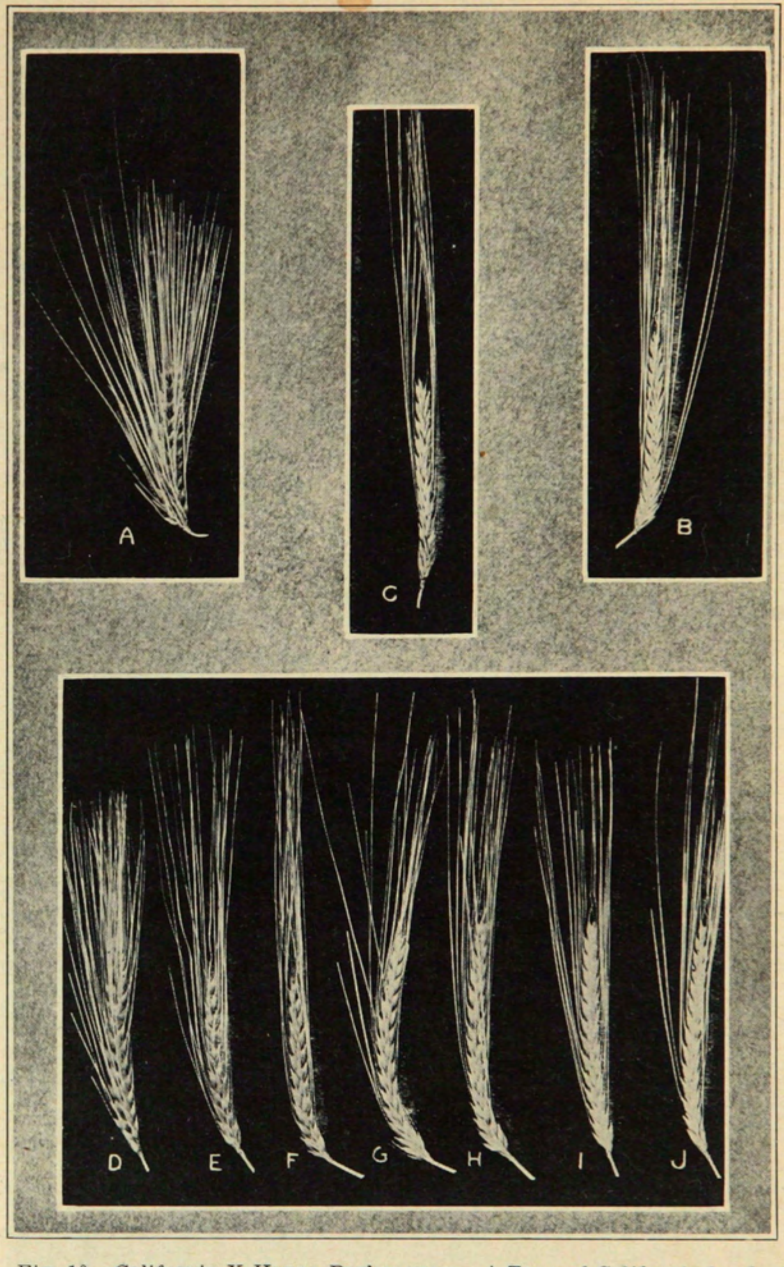

Fig. 10.—California X Hanna Barley cross. A Type of California head. B. Type of Hanna head. C. Head from F_1 plant. Notice that many of the lateral grains are developed but are not bearded. D. Typical California head occurring in the F_2 generation. Plants with such heads are true 6-row and give rise to only 6-row progeny. E, F, G, H, I, show various degrees of development of the lateral grains but none of the lateral grains are bearded. The lateral grains in E are almost normal. Invariably, such heads as these in our experience have been heterozygous with respect to the 2 and 6-row characters. J. A. typical 2-row Hanna head occurring in the F_2 generation. Such heads as these are homozygous 2-row and can be distinguished with considerable certainty.