VARIATIONS IN TYPES FOUND IN WINTOK AND CERTAIN OTHER CULTIVATED OAT VARIETIES GROWN IN OKLAHOMA

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By

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INTRODUCTION

One of the major problems confronting growers of certified seed oats in Oklahoma is to keep their seed clean from weed and other crop seed in order that they might have a better and more certain market for the seed produced.

In 1945 varying off-type kernels of oats were found in large numbers in Wintok C. I. [1]3424 grown for certification in Oklahoma. Some of these oat forms were classified as wild oats, Avena fatua,[2] which is considered a noxious weed in the state.

This experiment was undertaken because it seemed essential to know whether or not the off-type oat kernels in Wintok and other commercial oat varieties were actually wild or whether they were mutations from the variety, similar to those reported in numerous other oat varieties grown in the United States and other countries of the world.

By growing, observing, and classifying some of the varying oat forms, along with normal Wintok, other cultivated varieties, and common wild oats, it was hoped that some helpful conclusions could be drawn to aid Oklahoma certified seed growers as well as persons who inspect seed for certification. At the same time it seemed desirable to study the progeny of several of these oat forms so that plant and seed characteristics of these progeny could be compared with the normal cultivated oats in which they were found. Also it seemed desirable to compare the segregations, if any, of some of these oat types with the segregations reported by others.

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[1] C. I. refers to accession number of the Division of Cereal Crops and Diseases, U. S. Dept. of Agriculture.

[2] Oat forms in Wintok were classified by Buford Jones, Laboratory Superintendent, State Dept. of Agriculture, Oklahoma City, Oklahoma, and confirmed by W. H. Wright, Chief, Laboratory Service, Ottawa, Canada, as being wild, false wild, or heterozygous false wild types.

REVIEW OF LITERATURE

In 1936, Stanton (19)[3] stated that fatuoids or false wild oats had been observed in varieties of cultivated oats for many years both in North America and foreign countries. As a result of several years of study Coffman and Taylor (4) found that fatuoids were present in samples of Fulghum oats from 28 experiment stations in 17 states of the United States, however, these were not sufficiently numerous to be an economic weed problem in any locality, there being less than one percent in any population examined.

Several writers (15, 16, 17, 18, 19) observed fatuoid types in many varieties of common oats and also in cultivated red oats.

Garber (8) found fatuoids in three very different varieties of cultivated oats; namely Victory, Garton 784 and Aurora, and made the following statement; "These aberrant forms may be attributed more logically to mutations than to natural crossing of a cultivated variety and Avena fatua". Other writers (1, 2, 9, 14, 16) confirm Garber's view that fatuoids are the result of mutations rather than crosses of common wild (A. fatua) with cultivated varieties of oats.

Pepin and Wright (18) and others (4, 7, 15, 17, 18, 19) conclude that fatuoids differ from the cultivated varieties in which they occur by having long twisted geniculate awns and a large ring-shaped basal articulation (generally called a sucker mouth scar), with short stiff hair surrounding it. They found these characters in both the upper and lower grains of all spikelets. These writers also state that except for these fatuoid characters, the fatuoids resemble the oats in which they arise in color, shape, length

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[3] Figures in parenthesis refer to "Literature Cited", p. 32.

and plumpness. Pepin and Wright (18) further state that false wild oats (fatuoids) are looked upon as undesirable in high quality seed oats, but that considerable tolerance must be permitted since mutations may appear in any variety of cultivated oats.

Stanton, Coffman and Wiebe (20) found that in many respects fatuoid forms are similar to the variety in which they occur, but that all fatuoids possess certain characters in common. These common characters are also found in the common wild oat, A. fatua. These statements are rather similar to those made by several other writers (1, 4, 14, 17, 18, 19).

Poole and Coffman (21), in an investigation of dormancy in A. fatua, observed that seed from individual plants varied greatly in its promptness or lack of promptness to germinate. On the other hand, Coffman (1) reports that fatuoids tend to be prompt in germination or to have dormancy similar to the variety from which they are derived. Coffman and Stanton (3) stated that after storage for 7 to 10 weeks after harvest, all varieties except Tulghum, Victoria and the species Avena sterilis showed high germination at the end of 7 days.

Homozygous fatuoids tend to breed true if they are self fertilized, but some writers (11, 12, 16, 18) report that it is difficult to distinguish between homozygous and heterozygous false wild oats phenotypically. Stanton, Coffman, and Wiebe (20) recognized that on the basis of the breeding behavior four genotypes are apparent: (1) homozygous fatuoid, (2) heterozygous fatuoid, (3) heterozygous cultivated and (4) homozygous cultivated.

Heterozygous fatuoids segregate into three types of progeny: homozygous fatuoid, heterozygous fatuoid (or intermediate) and homozygous cultivated oats with a ratio of approximately 1:2:1 (14, 18).

It was reported by Coffman and Taylor (4) that natural crossing of

fatuoids is more likely than natural crossing in the common cultivated Fulghum. They stated that at the Arlington Experiment Farm in Virginia in 1932 more than 46.8% of the progeny of open-pollinated fatuoids apparently were crosses. Therefore, it may be stated that the common or "A type" fatuoid in Fulghum shows a varying tendency to be cross-pollinated unless foreign pollen is excluded. Coffman and Taylor further reported that homozygous cultivated Fulghum crossed less than 1% on an average for 5 years, whereas, Fulghum fatuoids crossed 11.6% for the same period of time.

According to Coffman and Wiebe (5) natural crossing occurred in 46 of 49 plants of Richland grown at varying distances from a black-kerneled variety at Aberdeen, Idaho in 1927. These 46 plants produced 18,110 progeny plants and the number of black aberrants was 232 or 1.28% of the whole. They further found that more crossed florets occurred in plants grown 1 foot from the nearest dark-kerneled plant than in those grown at a greater distance.

Garber and Quisenberry (10) stated that the extent of natural crossing between varieties of Avena sativa at Morgantown, West Virginia was relatively low. Among a total of 7,742 plants examined during three years only one natural cross was found. They further stated that based on a total of 1,708 plants, 0.41% crossing was found between Fulghum (female) and Victor (male).

Huskins (16) reported that many off-type kernels found in cultivated oat varieties are definitely mutants, while others are the product of natural crosses. He also reported that the types commonly described as false wild oats or fatuoids are mutants. Huskins further stated that the thesis that fatuoids arise through natural crossing between A. sativa and A. fatua is not maintained by any of the data written in its support when these data are critically examined.

According to Huskins (15) chromosomes bearing factors for the fatuoid

complex appear to be regularly present in ordinary varieties of A. sativa and certain other closely related species. Huskins further observed that until certain chromosome irregularities occur the action of these fatuoid factors are masked by the action of other factors which produce the normal types. The occurrence of fatuoids and the uniformity of their characteristic features may be considered a point of evidence favoring this conclusion. Further support is found in the observation that varieties of oats which are normally practically awnless, will under certain growing conditions produce spikelets with very large, twisted, geniculate awns on the primary grains. Also, these grains may have a slightly heavy, heterozygous-fatuoid-like base.

Heterozygous fatuoids bear little or no resemblance to A. fatua and this oat form is almost always indistinguishable from the cultivated A. sativa, according to Garber (8), Huskins (16), and Stanton (19). These writers further state that only the primary kernels have heavy twisted geniculate awns with bases very similar to those of A. sativa oats.

Pepin and Wright (18) report that homozygous false wild oats are not as objectionable as heterozygous false wild oats[14] because they shatter early; consequently only a small proportion of the grains ever reach the seed-bin. Heterozygous false wild oats do not tend to do this and they segregate rather definitely on the basis of a 1:2:1 ratio with normal, heterozygous false wild and homozygous false wild forms.

In a report in 1946 Huskins (16) stated that almost invariably the fatuoids are segregates from heterozygous fatuoids, these latter forms really being the ones whose origin from normal cultivated oats has to be explained.

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[14] The heterozygous false wild oats of Pepin and Wright apparently include the 2 classes heterozygous fatuoid and heterozygous cultivated of Stanton, Coffman, and Wiebe (20).

Goulden (11) concludes that the progeny of otherwise normal plants heterozygous for the false wild factor usually consists of a 1:2:1 ratio of false wild, intermediate and cultivated individuals. When dwarfs occur in families from such plants, however, the cultivated class is practically eliminated and the remainder consists of false wild dwarfs and intermediate normals in a 1:1 ratio.

From preliminary studies on the chromosome behavior of the fatuoid dwarf mutant Derick and Love (6) report that it appeared certain that this form is more irregular than the parent dwarf.

Harlan (13) made the statement that wild oats had the ability to grow in accordance to the crop in which it was found; that is, if the crop were in the winter rosette stage, wild oats would be in the rosette stage also. Harlan also stated that if the crop were heading, the wild oats would be heading and on the same day all stages of wild oats could be found.

MATERIALS AND METHODS

This experiment was conducted during the period of 1945-1948 inclusive, in the Agronomy greenhouse and in the field on the Agronomy farm of the Oklahoma Agricultural Experiment Station.

Varying oat forms found in the variety Wintok in 1945 were classified as wild (A. fatua), false wild and heterozygous false wild oats. These classifications were made by Jones[15] and confirmed by Wright[15], who also supplied some false wild and heterozygous false wild oats from Canadian stock as a standard. These varying forms were planted by C. B. Cross[16] and Jones

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[15] See footnote 2, p. 1.

[16] Formerly Associate Agronomist, Oklahoma A. & M. College.

in individual pots in the greenhouse and this material was submitted to the writer for further study. Plants from seeds of the various classes were assigned selection numbers as follows:

Wild oats (from Wintok samples) - - - - - - - - - - - 1 to 20

False wild (from Canadian stock) - - - - - - - - - - 21 to 32

Heterozygous false wild (from Canadian stock) - - - 33 to 41

False wild (from Wintok) - - - - - - - - - - - - - - 42 to 46

Heterozygous false wild (from Wintok) - - - - - - - 47 to 51

In addition, several fatuoid or false wild kernels were selected from Wintok oats by Cross in the summer of 1945. These kernels were space-planted in the field in row 4003 on the Agronomy farm in the fall of 1945. From this row 28 plants were harvested in the spring of 1946. Phenotypic classifications were made of the seed from the 28 plants. These plants were assigned selection numbers 4003-1 to 4003-28 inclusive. The seeds that produced these plants were originally classified as fatuoids by Cross. This portion of the study also was submitted to the writer.

Observations were made for these off-type characters in other varieties growing on the Agronomy farm and some were found in Kanota, Winter Turf, Arkansas 160, Winter Fulghum C. I. 2500, and Columbia.

Plantings were made from these 1946 harvested seeds in both the greenhouse and in the field in the fall of 1946 and again in the field in the spring of 1947. Seed from several of these plants were harvested individually and others were bulked because they were thought to be of the same type.

In the fall of 1947 plantings were made from seed harvested from the 1946 and the 1947 crops along with some Canadian stock oats furnished by Wright, some common wild (A. fatua) from two sources (New Mexico and

Oregon)[17], and normal variety checks so that plant and seed comparisons could be made. In all cases the seeds were space-planted so that individual plants and seed from individual plants could be harvested and classified separately.

Wintok referee samples sent to the Oklahoma Crop Improvement Association Office for seed inspection for certification were examined for fatuoids for each of the 4 years 1945-1948 inclusive.

RESULTS AND DISCUSSION

Results presented in this paper represent a three-year study of seed and plant characters of various oat forms found in Wintok and other commercial varieties of oats grown in Oklahoma.

The original classification of forms of oats from Wintok and Canadian stock grown in the greenhouse in 1946-1947 is given in Table 1. This classification was made by Jones and confirmed by Wright. The 1946 classification was made by the writer. From the 20 seeds originally classified as wild oats 16 plants were obtained. All of these plants were classified as fatuoids in 1946 except plant 7 (see Table 1). Because no fatuoid or "wild-like" characters were apparent, the seed from this plant were classified as normal. However, as will be discussed in a later paragraph the progeny from plant 7 segregated so it was reclassified as normal to heterozygous, since many normal to heterozygous types cannot be distinguished phenotypically.

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[17] New Mexico seed collected by Dr. A. M. Schlehuber, Agronomist, Oklahoma A. & M. College, near Raton, New Mexico in August 1946. Oregon seed sent to the Agronomy Dept., Oklahoma A. & M. College for identification in January, 1947, by B. F. Freeman, Malin, Oregon.

Table 1.--Classification of forms of oats from Vintok and Canadian stock grown in the greenhouse in 1946.

Original Classification	Classification 1946[1]	Plant selection numbers
Wild oats (from Vintok samples	F. N. to H.	1, 4, 5, 6, 8-17, 19 7
False Wild (from Canadian stock)	F.	21, 24, 25, 26, 28, 30, 31, 32
Heterozygous (from Canadian stock)	F. H. to H.	33 34-38, 41
False Wild (from Vintok)	F. N. to H.	42, 43, 44, 46 45
Heterozygous (from Vintok)	H. H. not Vintok type	47 48, 49, 51

[1] F. - fatuoid; H. - heterozygous; N. - normal; N. to H. - normal to heterozygous.

Figures 1 and 2 illustrate how difficult it is to distinguish heterozygous cultivated from normal Wintok oats. The heterozygous cultivated (Fig. 1, A) segregated in a ratio of approximately 3 normal to heterozygous : 1 fatuoid. By growing this material another generation the genotypic ratio of 1 normal : 2 heterozygous : 1 fatuoid was obtained. E (Fig. 2) is a common wild oat, A. fatua. and B is a homozygous fatuoid from Wintok. C (Fig. 1) and F (a) and (b) (Fig. 2) segregated the next generation in a ratio of 3:1 similar to A (Fig. 1). D (Fig. 1) and G (a) and (b) (Fig. 2) bred true to normal type.

Except for plant 45 plants originating from seed classified as fatuoid or false wild (from Wintok) produced fatuoid type seed. Plants 48, 49, and 51, from seed classified as heterozygous (from Wintok), produced seed that was not Wintok type, but was classified as heterozygous. The following generation bred true to type and was classified as normal to heterozygous oats.

The classification of the 1947 field-grown progeny from seed produced in the greenhouse in 1946 and the parent phenotypes are shown in Table 2. The progeny classifications by plants are given as fatuoid and normal to heterozygous. The original seed that produced plant 11 was classified as fatuoid in 1946; however, from the 19 plants grown in the following generation, 4 plants produced fatuoid-like seed and 15 produced normal to heterozygous type seed.

The 1947 parent phenotypes, the phenotypic classification in 1948 and the descriptions of plants are shown in Table 3. Several rows of normal Wintok checks were planted in 1947. From a total of 295 plants, 8 produced fatuoid-like seed and 287 produced normal to heterozygous seed. Seeds from plant 7 classified as normal to heterozygous (Table 1) were grown in 1948. Five plants were grown from a random sample of seed from plant 7. One

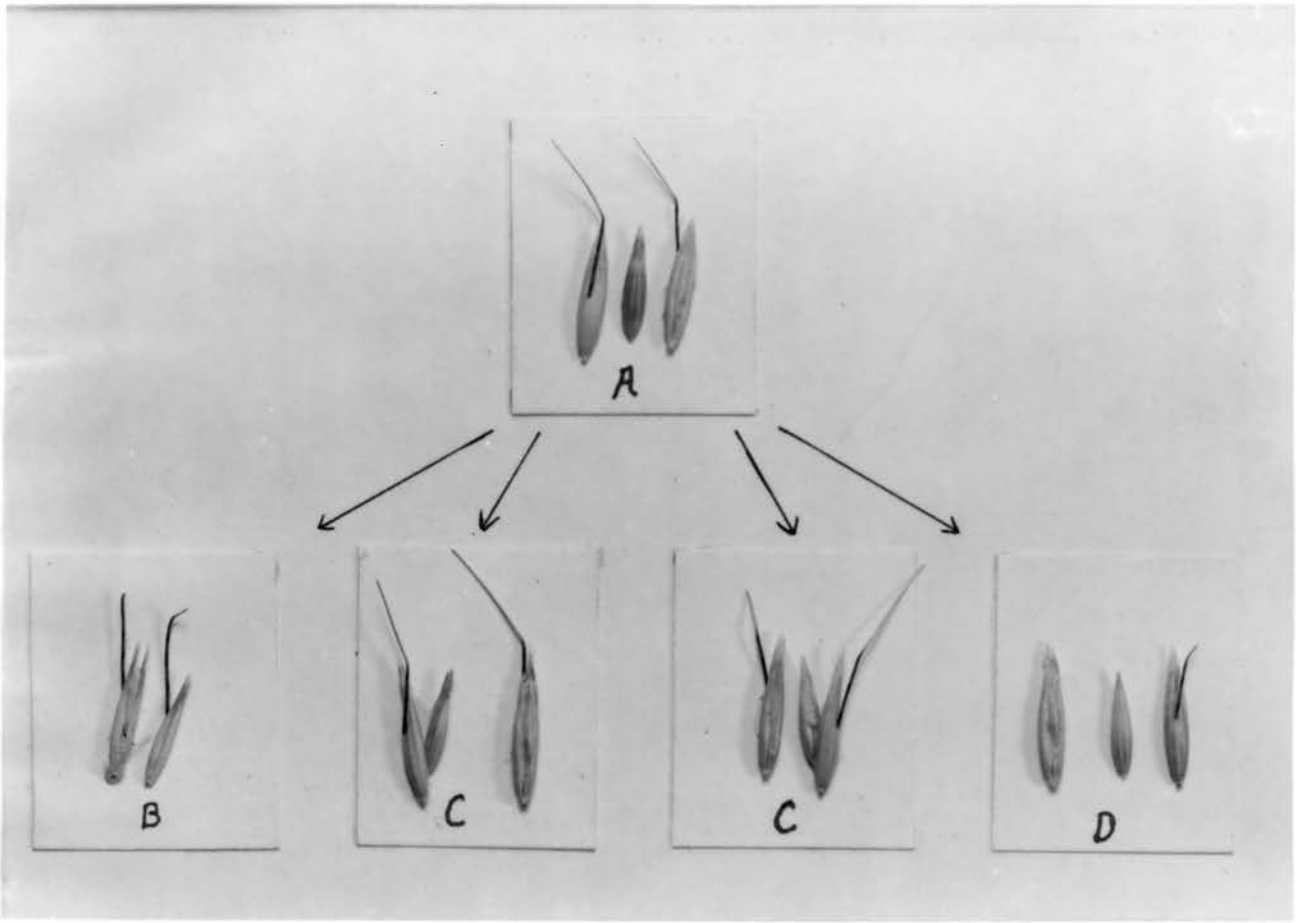

Figure 1.--A-Heterozygous Wintok. B-Homozygous fatuoid from Wintok.
C-Heterozygous Wintok. D-Homozygous or normal Wintok.

A and C segregated very close to a 1:2:1 ratio.
B and D bred true to type.

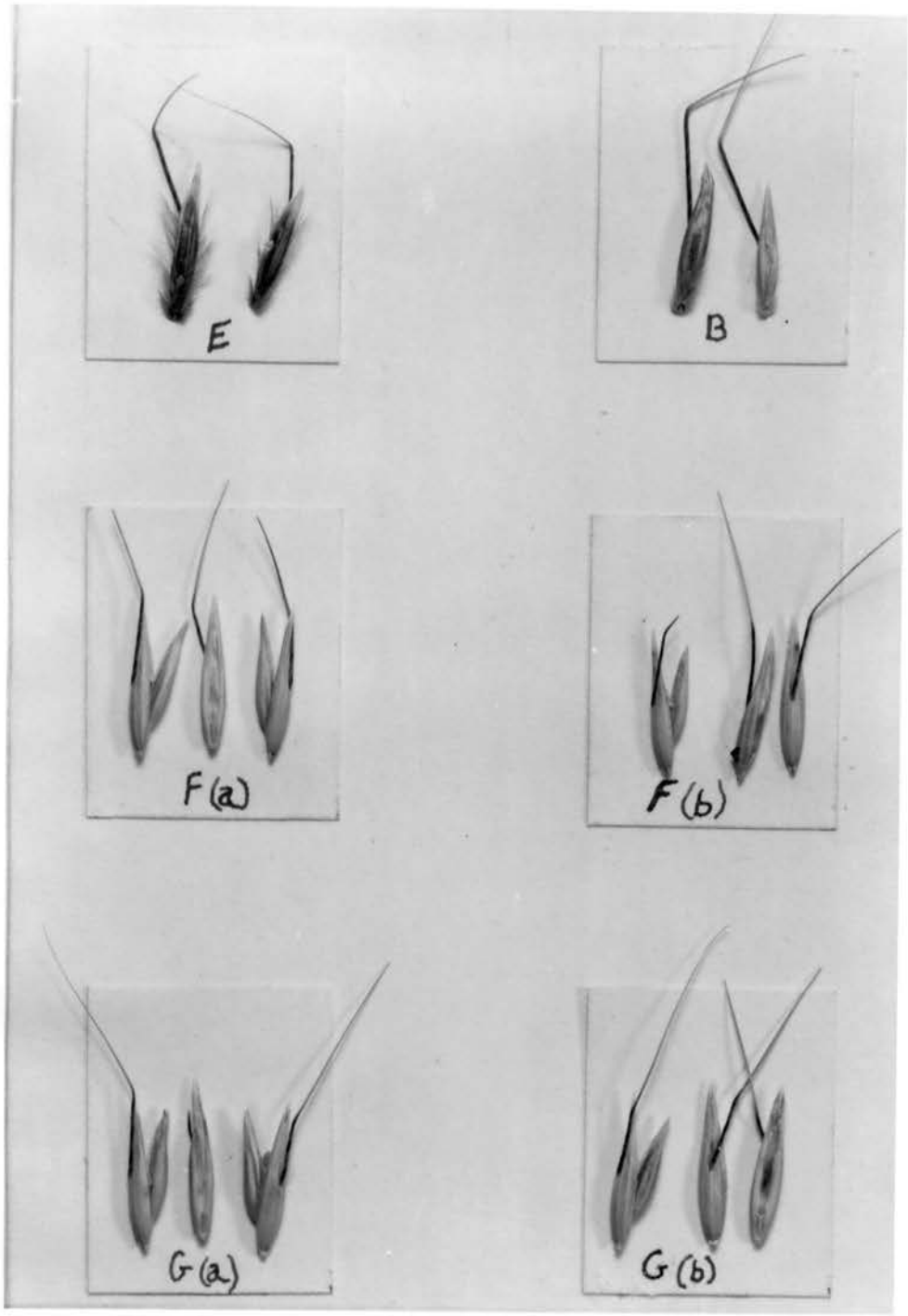

Figure 2.--E-Common wild (Avena fatua) from New Mexico. B-Homozygous fatuoid from Wintok. F (a and b)-Heterozygous Wintok. G (a and b)-Homozygous Wintok.

Table 2.—Classification of the 1947 field-grown progeny from seed grown in the greenhouse in 1946.

Variety or Sel. No.	Parent phenotype	Total No. plants	Phenotypic classification of progeny	
			F.	H. to H.
Vintok (ck.) (C. I. 3424)	H.	28	0	28
1, 4, 8, 9, 12, 17, 42, 46, 49	F.	44	44	0
5, 13, 14	F.	0	0	0/1
11	F.	19	4	15
21, 24, 25, 31, 32, 33	F.	0	0	0/1
34	H. to H.	2	0	2
36	H. to H.	3	3	0
37	H. to H.	11	1	10
38-41	H. to H.	0	0	0/1
45	H. to H.	7	2	5
47	H.	1	1	0
48	H.	0	0	0/1
51	H.	1	1/2	0

/1 Plants winter-killed.

/2 Classified as heterozygous in 1947; reclassified as fatuoid since no segregation occurred in 1947 or 1948.

Table 3.--Classification of forms of oats grown in 1948 from Wintok and Canadian stocks grown in the greenhouse in 1946 and in the field in 1947.

Variety or Sel. No.	Parent phenotype	Total No. plants	Phenotypic classification		Plant description
			F.	M. to H.	
Wintok (ck.)	M.	295	8	287	Dark green leaves; prostrate growth (Wintok type)
7	M. to H.	5	1	4	Wintok type.
7-(1)[1]	H.	60	15	45	Wintok type.
7-(2)	M.	34	0	34	Wintok type.
34-1 and 34-2[2]	H.	20	0	20	Large light green leaves; bred true.
35	M. to H.	5	0	5	Not Wintok type; bred true.
35-(1)	H.	16	0	16	Large light green leaves; large stems; bred true.
35-(2)	M.	16	0	16	Large light green leaves; large stems; bred true.
36	M. to H.	14	0	14	Large light green leaves; large stems; bred true.
36-1[3]	H.	11	0	11	Large light green leaves; large stems; bred true.
37	M. to H.	14	3	11	Large light green leaves; large stems; bred true.
37-(1)	H.	27	3	24	Large light green leaves; large stems; bred true.

Table 3.--Contd.

Variety or Sel. No.	Parent phenotype	Total No. plants	Phenotypic classification F.	Phenotypic classification N. to N.	Plant description
37-(2)	N.	27	0	27	Large light green leaves; large stems; bred true.
38-1	N.	20	0	20	Large light green leaves; large stems; bred true.
41-1	N. to N.	4	0	4	Large light green leaves; large stems; bred true.
45	N. to N.	22	0	22	Wintok type.
45-1	N.	25	7	18	Wintok type.
45-2	F.	17	17	0	Wintok type.
45-(3)	N.	72	15	57	Wintok type.
45-(4)	N.	48	11	37	Wintok type.
48-1 and 48-2	N.	26	0	26	Not Wintok type; bred true.
49	N.	12	0	12	Not Wintok type; bred true.
49-1 and 49-2	N.	33	0	33	Not Wintok type; bred true.
51-1	N.	13	0	13	Open basal scar; weak awn; bred true; not Wintok type.

/1 7-(1) - seed selected for normal or heterozygous from bulked seed of two or more plants grown in 1947.

/2 34-1 and 34-2 - two individual plants; data combined.

/3 36-1 - individual plant selection grown in 1947.

produced fatuoid-type seed and 4 produced seed classified as normal to heterozygous. Seed from the progeny of plant 7 grown in 1947 was classified as normal to heterozygous and was bulked. From this bulked seed two separate lots were selected. One of these lots 7-(1), contained seed selected as heterozygous and the other, 7-(2), was made up of seed selected as normal to heterozygous. Sixty plants were grown from 7-(1); 15 of these produced fatuoid-like seed and 45 produced seed classified as normal to heterozygous. All of the 34 plants grown from 7-(2) produced normal type seed. The seed selected for normal Wintok had very weak awns; however, some normal Wintok oats have very heavy twisted, geniculate awns on the primary kernels. In some cases where the parent phenotype was classed as heterozygous or normal to heterozygous segregation occurred in the progeny. In other cases, however, no segregation was obtained. Seed from the bulk, 45-(4), selected as normal Wintok produced both fatuoid and normal to heterozygous types.

A summary of a portion of the information given in Tables 1 to 3 is shown in Table 4. The original classification by Jones and Wright and the classification of the 1946 harvested seeds by Miss Albina F. Musil[18] and the writer are shown in this table. The phenotypic classifications of the 1947 and 1948 progeny are also shown. With the exception of plant 7 the seeds from plants grown from seed classified by Jones and Wright as wild oats (from Wintok samples) were classified as fatuoids. Plant 7 was classified as heterozygous-fatuoid by Musil and normal to heterozygous by the writer. As mentioned previously when the progeny of this plant was grown in 1948 segregation occurred with 1 plant producing fatuoid type seed and 4 plants producing

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[18] Associate Botanist, Division of Forage Crops and Diseases, Beltsville, Maryland.

Table 4.--Classification of oat forms grown in the greenhouse in 1946 and of the progeny grown in the field in 1947 and 1948.

Original classification[1]	Classified by: Plant No.	R.M.G.[2] 1946	A.F.H.[3] 1946	Phenotypic classification of the progeny 1947	1948
Wild oats (from Vintok samples)	1	Fatuoid	Fatuoid	Fatuoid	
	4	Fatuoid	Fatuoid	Fatuoid	
	5	Fatuoid	Fatuoid	Fatuoid	
	6	Fatuoid	Probably fatuoid	Fatuoid	
	7	N. to K.	K.-F.	- - - -	1 F.:4 N. to K.
	8	Fatuoid	Fatuoid	Fatuoid	
	9	Fatuoid	Fatuoid	Fatuoid	
	10	Fatuoid	Fatuoid	- - - -	
	11	Fatuoid	Fatuoid	Fatuoid	
	12	Fatuoid	Too immature to determine	Fatuoid	
	13	Fatuoid	Too immature to determine	Fatuoid	
	14	Fatuoid	Fatuoid	Fatuoid	
	16	Fatuoid	Too immature to determine	- - - -	
	17	Fatuoid	Fatuoid	Fatuoid	
	19	Fatuoid	Fatuoid	- - - -	

Table 4.--Contd.

Original classification[1]	Plant No.	Classified by: R.M.O.[2] 1946	Classified by: A.F.M.[3] 1946	Phenotypic classification of the progeny 1947	1948
False wild (from Canadian stock)	21	Fatuoid	- - - -	Fatuoid	
	24	Fatuoid	- - - -	Fatuoid	
	25	Fatuoid	- - - -	Fatuoid	
	31	Fatuoid	- - - -	- - - -	Fatuoid
	32	Fatuoid	- - - -	- - - -	Fatuoid
Heterozygous (from Canadian stock)	33	Fatuoid	- - - -	- - - -	Fatuoid
	34	N. to H.	- - - -	N. to H. large sun on primary kernel.	- - - -
	35	N. to H.	- - - -	- - - -	N. to H.
	36	N. to H.	- - - -	N. to H.	N. to H.
	37	N. to H.	- - - -	1 F:10 N. to H.	6 F: 62 N. to H.
	38	N. to H.	- - - -	- - - -	N. to H.
	41	N. to H.	- - - -	- - - -	N. to H.
False wild (from Wintok)	42	Fatuoid	Fatuoid	Fatuoid	- - - -
	43	Fatuoid	Fatuoid	- - - -	- - - -
	44	Fatuoid	Fatuoid	Fatuoid	- - - -
	45	N. to H.	May be some type of A. byzantina or H.-F.	2 F. :5 N. to H.	50 F. :134 N. to H.
	46	Fatuoid	Fatuoid	Fatuoid	- - - -

Table 4.--Contd.

Original classification [1]	Plant No.	Classified by: R.M.O. [2] 1946	Classified by: A.F.M. [3] 1946	Phenotypic classification of the progeny: 1947	Phenotypic classification of the progeny: 1948
Heterozygous (from Wintok)	47	H.	H.-F.	H. Not Wintok type.	- - - -
	48	N. Not Wintok type	H.-F.	H. (reclassified as F.)	Bred true.
	49	N. Not Wintok type	H.-F.	H. (reclassified as F.)	Bred true.
	51	N. Not Wintok type	H.-F.	H. (reclassified as F.)	Bred true.

[1] Original classification, by Jones and Wright.

[2] The writer.

[3] Miss Albina F. Musil.

normal to heterozygous type seed.

Plants 33 to 41 inclusive classed as heterozygous (from Canadian stock) as shown in Table 4 were quite different in breeding behavior. Plant 33 was classed as fatuoid in 1946 and 1948. Plant 34 was classed as normal to heterozygous in 1946 and 1947. Plants 35, 38 and 41 were classed as normal to heterozygous in 1946 and again in 1948. Plant 36 was classed as normal to heterozygous in 1946, 1947 and 1948. Plant 37 was classed as normal to heterozygous in 1946 and segregated in 1947 and in 1948.

Except for plant 45, all plants classified as false wild (from Vintok) bred true to type. In 1946 plant 45 produced seed that was classed as normal to heterozygous by the writer and as heterozygous-fatuoid or some type of A. byzantina by Musil. Seed from plant 45 produced 2 fatuoid and 5 normal to heterozygous individuals in 1947 and 50 fatuoid to 134 normal to heterozygous type plants in 1948.

Seeds originally classified as heterozygous (from Vintok) plants 47, 48, 49 and 51 produced plants which were classified as heterozygous by the writer and heterozygous-fatuoid by Musil. These all bred true to type in 1947. Plants 48, 49 and 51 were reclassed as fatuoid in 1947 by the writer and bred true to type in 1948.

Phenotypic classifications of the plants grown in the field in 1946 are given in Table 5. Plants 4003-2, -14, -17, -18, -22, and -23 produced seeds that were put into the normal to heterozygous type group as they did not have the "wild-like" characters of fatuoid types. Plants 1, 3 to 13, 15, 16, 19, 21, and 24 to 28 produced seed classified as fatuoids.

The phenotypic classifications of the next generation of some of this material (grown in 1947) are shown in Table 6. Classifications are also given for additional material grown in the field in 1947. The progeny

Table 5.--Classification of forms of oats from Wintok grown in the field in 1946.

Original classification [1]	Classification of progeny in 1946	Plant selection numbers
Fatuoid	Fatuoid	4003-1, -3 to -13, -15, -16, -19, -21, -24 to -28
Fatuoid	H. to H.	4003-2, -14, -17, -18, -22, -23

[1] C. B. Cross, formerly Associate Agronomist, Oklahoma A. & M. College, made the original classification of this lot of seed.

Table 6.--Classification of the 1947 field grown progeny of oat forms grown in the field in 1946.

Sel. No. or Variety	Parent phenotype 1946	Total No. of plants	Phenotypic classification of the 1947 progeny.		
			F.	H. to H.	W.[1]
Wintok (ck.) (C. I. 3424)	H.	75	0	75	0
4003-2	H. to H.	13	13	0	0
4003-4,-6,-8, -10,-11,-12, -14,-16,-21, -24,-25,-26,-28	F.	100	100	0	0
4003-3	F.	17	5	12	0
4003-9	F.	8	3	5	0
4003-17	H. to H.	3	1	2	0
4003-18	H. to H.	20	5	15	0
4003-22	H. to H.	8	5	3	0
4003-14, -23	H. to H.	21	0	21	0
Winter Turf	F.	14	14	0	0
Winter Turf (ck.)	H.	8	0	8	0
Arkansas 160-1, -2, -3	F.	27	27	0	0
Arkansas 160 (ck.)(C. I. 2502)	H.	18	0	18	0
Columbia (C. I. 2820)	H.	57	0	57	0
Columbia	F.	9	9	0	0
Columbia	Groat[2]	7	0	7	0
Wild (New Mexico)	W.	5	0	0	5
Wild (Oregon)	W.	3	0	0	3
Canadian Stock	F.	10	10	0	0

[1] W. - Wild oats, Avena fatua.

[2] Naked seed.

classification in some cases did not confirm the phenotypic classification of the parent material. For example, seed from 4003-2 classed as normal to heterozygous in 1946, the 13 plants grown produced fatuoid-like seed. 4003-3 and 4003-9 classed as fatuoid in 1946 segregated in 1947 as shown in this table. Seed from plant 4003-3 was classified as fatuoid in 1946, but segregated, 5 fatuoid to 12 normal to heterozygous as shown in Table 6. Seed from this same source was reclassified (phenotypically) as heterozygous. Some of this same lot of seed was grown again and segregated 1 fatuoid to 5 normal to heterozygous as shown in Table 7. The two seedings combined gave a segregation of 17 normal to heterozygous to 6 fatuoid or closely approximating a 3 to 1 ratio.

From 4003-3-(2)(seed that was bulked from two or more plants) 55 plants were grown; 10 of these plants produced seed that was classified as fatuoid and 45 plants produced normal to heterozygous type seed. Seed from plant 4003-9 was classified as fatuoid in 1946. Eight plants were grown from seed from plant 4003-9 in 1947 and 4 in 1948 with a segregation of 9 normal to heterozygous and 3 fatuoid for a combination of the two years.

Classification of the field-grown progeny of Wintok and other oat forms grown in the greenhouse in 1948 is shown in Table 7. Five plants were grown in 1948 from seed of plant 4003-3-4 which was classified as a dwarf fatuoid as shown in Table 7. Four of these plants produced fatuoid-like seed and 1 produced seeds that were classified as normal to heterozygous. Plant 4003-28-1 was also classified as a dwarf fatuoid. Ten plants were grown from this seed and 8 produced fatuoid types and 2 produced normal to heterozygous seed.

From spring seeding in 1947, seed from plant 37 (Canadian stock) produced a dwarf-like plant with fatuoid type seed. This plant had leaves with very light green veins about 1/8 inch wide, running length-wise of the leaf.

Table 7.--Classification of the progeny of Wintok and other oat forms grown in the greenhouse in 1948.

Sel. No. or Variety	Parent phenotype 1947	Total No. of plants	Phenotypic classification of progeny 1948		
			F.	M. to F.	W. [1]
4003-3	F.	6	1	5	-
4003-3-(2)	M. to F.	55	10	45	-
4003-3-4	D.-F.	5	4	1	-
4003-9	F.	4	0	4	-
4003-9-(1)	M. to F.	36	3	33	-
4003-14-(1)	M. to F.	28	0	28	-
4003-17-1	D.-F.	10	8	2	-
4003-17-(2)	M. to F.	36	8	28	-
4003-18	M. to F.	7	2	5	-
4003-18-(1)	M. to F.	25	2	23	-
4003-22	M. to F.	6	0	5	-
4003-22-1	F.	35	5	30	-
4003-22-(2)	M. to F.	27	3	24	-
4003-23(1)	M. to F.	25	0	25	-
4003-28-1	M. to F.	10	8	2	-
37-1 [2]	D.-F.	5	0	5	-
Mindo (C. I. 4328)	F.	2	0	2	-
Ventura (C. I. 3989)	F.	2	0	2	-
Wild oats (New Mexico)	W.	5	0	0	5

[1] W. - Wild oats, A. fatua.

[2] 37-1 - A fatuoid-dwarf plant with light green leaves.

These veins were almost devoid of chlorophyll. Some seeds were planted from this plant and the 5 plants grown did not have the leaf character as explained above and the seed from these plants were classified as normal to heterozygous (Table 7).

The manner in which the progeny segregated from plants thought to be dwarf fatuoids indicates that they may have been misclassified. Of the 30 progeny grown, 20 were classed as fatuoid and 10 as normal to heterozygous. The plants were not dwarfed as the parent plants seemed to be and the segregation was quite different from that reported by Goulden (11). He reported that when dwarf fatuoid seed are grown the normal cultivated class is practically eliminated and the remainder consists of false wild dwarfs and intermediate normals in 1:1 ratio.

Classifications of Wintok oat seed forms by Husil, Dr. T. R. Stanton[9], F. A. Coffman[10] and the writer are given in Table 8. Some of these oat forms were grown in 1948 and the progeny were classified as to phenotypic types as shown in the table.

It was very difficult to make a phenotypic classification of the seed of some plants. For example, plant 4003-3 produced seed that appeared normal to Husil and the writer but Stanton stated they were apparently heterozygous fatuoids and that some of them might be intermediate in type; Coffman stated that possibly they were heterozygous fatuoids. Six plants were grown from this lot of seed in 1948 and there was no apparent segregation.

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Table 8.--Phenotypic classification of oat forms derived from Wintok.

Sel. No.	Phenotypic classification by:				1948 progeny	
	T.R.S.[11]	A.F.M.[12]	F.A.C.[13]	R.M.O.[14]	Phenotypic Classification	No. of plants
4003-3	Apparently H.-F.[15] However some may be inter.	Appears to be normal oats	Possibly a H.-F. for it seems to produce F.	Appears H.	1 F.:5 H. to H.	6
4003-3-1	F. Should breed true.	F.	F.	F.	F.	5
4003-3-(2)	These look like mostly cult. forms, some may be inter.	Appears H., few seed approach H. type. Not positive.	May be either twisted geniculate awned cult. or H.-F. grow to determine.	Appears H.	7 F.:30 H. to H.	37
4003-9	H.-F.	Appears H.	Evidently a H.-F.	Appears H.	Appears H.	4
4003-9-1	F.	F.	F.	F.	Not grown	-
4003-9-(2)	H.-F. and cult., confirm only by growing	Appears H.	Looks like heavy awned cult., yet some may be H.-F.	Appears H.	3 F.:14 H. to H.	17
4003-14	- - - -	Appears H.	- - - -	Appears H.	Appears H.	8
4003-14-(1)	- - - -	Appears H.	- - - -	Appears H.	Appears H.	22
4003-12-(1)	- - - -	Appears H.	- - - -	Appears H.	5 F.:25 H. to H.	30
4003-18	Should segregate, next generation. Inter. F. and cult. Probably ok for H.-F.	Appears H.	Probably H.-F.	Appears H.	2 F.:5 H. to H.	7

Table 8.—Contd.

Sel. No.	Phenotypic classification by: T.R.S.[1]	A.F.H.[2]	J.A.C.[3]	H.H.C.[4]	1948 progeny: Phenotypic classification	No. of plants
4003-18-1	F. should breed true	F.	F.	F.	Not grown	-
4003-18-2	Probably contains both cult. and H. forms.	Appears H.	Possibly H.-F.	Appears H.	2 F.:23 H. to H.	25
4003-22	Cult. type, but some may be inter.	Appears H.	Possibly inter. or H.-F.	Appears H.	Appears H.	4
4003-22-1	H.-F.	Possibly H.-F.	Possibly inter. or H.-F.	H.-F.	3 F.:16 H. to H.	19
4003-22-(2)	Cult. type, but some may be H.-F.	Appears H.	May be only heavy geniculate awned cult.; grow to determine.	Appears H.	3 F.:16 H. to H.	19
4003-22-(1)	- - - -	Appears H.	- - - -	H.	H.	16

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[2] Miss Albina F. Musil, Associate Botanist, Division of Forage Crops and Diseases, Beltsville, Maryland.

[3] Dr. F. A. Coffman, Senior Agronomist, Oat Investigations, Division of Cereal Crops and Diseases, Beltsville, Maryland.

[4] The writer.

[5] H.-F. - heterozygous-fatuoid; H. - normal; cult. - cultivated; inter. - intermediate; H. - heterozygous; F. - homozygous-fatuoid.

In 1947 seed from plant 4003-3-1 was classified as homozygous fatuoid by each individual. Five plants were grown from this lot of seed in 1948 and bred true to fatuoid characters. Another lot of seed designated as 4003-3-(2) (Table 7), which was seed from two or more plants bulked because they appeared normal, appeared as mostly cultivated forms to Stanton but he stated that some might be intermediate. Musil said they appeared normal, but that a few seed approached heterozygous types, and that she could not be positive. On the other hand, Coffman concluded that they might be either twisted geniculate-awned cultivated or heterozygous fatuoids and that it would be necessary to grow them to determine their proper classification. In 1948, 37 plants were grown from this lot of seed and classified as 7 fatuoids and 30 normal to heterozygous.

A comparison of the classifications given in Table 8 should help others to understand that it is very difficult to distinguish some of these oat forms found in Wintok, when grown under Oklahoma conditions. The off-type forms showing up in cultivated oats in the state evidently are not A. fatua, but they are more than likely mutants from the variety in which they are found.

The classification of oat forms observed in Wintok seed sent to the Oklahoma Crop Improvement Association Office for final inspection for certification is shown in Table 9. Of 106 samples examined during a period of four years only 82 off-type seeds were observed. These samples consisted of approximately 1,000 seeds selected at random from a two or three pound lot sent in for inspection. The 1945 samples had more fatuoid or off-type kernels than the 1946 samples and there were decreasing numbers in 1947 and 1948. This decrease might have been caused either by more rigorous cleaning of the seed by the grower or by climatic conditions experienced in the three latter years.

Table 9.—Classification of oat forms observed in referee samples of Wintok received by the Oklahoma Crop Improvement Association for seed certification inspection.

Year	No. seed examined	No. fatuoids found[1]	Percent of fatuoids
1945	9,000	49	0.544
1946	50,000	28	0.056
1947	28,000	4	0.014
1948	19,000	1	0.005
Total	106,000	82	0.077

[1] Phenotypic classification.

SUMMARY

Data presented in this study indicate that the varying oat forms found in Wintok in 1945 were incorrectly classified as wild oats. That some of these off-type kernels found in Wintok possess characters that are very similar to common wild oats A. fatua, is not questioned. However, by growing and classifying both plants and seed and comparing them with normal Wintok, it appears rather obvious to the writer that the oat forms found in Wintok, are not common wild, A. fatua. For example, one plant (No. 7), originally classified as wild, A. fatua, must have been a heterozygous fatuoid type. The seed from this plant was classified as being normal to heterozygous cultivated or normal Wintok type (Table 3).

Plant and kernel characters of these oat forms when grown under the same conditions are very similar to normal Wintok oats. Progeny from these off-type seeds were indistinguishable from normal Wintok plants in both growth and winterhardiness. The only apparent differences were the "wild-like" characters observed on the seed. All fatuoids possessed an open basal scar with hair around the scar and along the rachilla, whereas the A. fatua used in this experiment had hair around the basal scar, the rachilla and over the lemma and palea.

While homozygous and heterozygous fatuoids were very difficult to classify phenotypically, it was the homozygous and the heterozygous cultivated types that provided the most difficulty in classification. In every case it was necessary to grow these oat forms to have any degree of certainty of the classification.

Plants from Canadian stock seed and common wild, A. fatua, from fall seeding in the field winterkilled almost 100%. The type of growth of plants

from Canadian stock and common wild oat seed were quite different from Wintok plants. The plants from both fall and spring seeding had much wider leaves and larger stems than Wintok. Wintok plants have a prostrate growth habit in the early stage, while A. fatua plants have an upright habit of growth.

Fatuoids from Wintok matured about the same time as normal Wintok, whereas all wild oats, A. fatua, matured much later. This is contrary to Harlan's (13) observations of wild oats. He stated that wild oats grow as their neighbors grow; if the plants of the crop were in the rosette stage, the wild oats also would be in the rosette stage; if the crop was about to mature the wild oats also would be ready to mature. Harlan said, "length of day may rule barley and wheats but not with the oats, 'keeping up with the Joneses', is the governing factor". This was not true with the A. fatua used in this experiment. Two sources of wild oat seed were used, one from New Mexico and one from Oregon. These A. fatua bred true to type.

Plants selected for fatuoid dwarfs did not breed true for dwarf characters, nor did they segregate in the manner reported by Goulden (11).

Referee samples of Wintok obtained from the Oklahoma Crop Improvement Association were examined for fatuoids. The 1945 samples contained more fatuoids than those from the 1946, 1947 and 1948 crops. There was only one fatuoid in the 19 seed samples examined in 1948.

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