



Inheritance of lateral spikelet fertility in a barley cross of Glacier with Compana  
by Dale G Smeltzer

A THESIS Submitted to the Graduate Committee in partial fulfillment of the requirement for the degree  
of Master of Science in Agronomy at Montana State College

Montana State University

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Abstract:

A cross was made of Glacier, a six-rowed variety, with Compana, a two-rowed variety of barley. the F<sub>3</sub> segregation for spike row character and lateral spikelet fertility is reported\* the two-rowed versus six-rowed character was found to be controlled by a single genetic factor pair, the segregation ratio was three non-six-rowed types to one six-rowed type\* Two Intermediate spike type# were found in F<sub>2</sub>, some having infertile lateral spikelets, sad others had some seed set in the laterals. These appeared In F<sub>2</sub> in a ratio of three infertile to one fertile, there were two types of segregations observed in F<sub>3</sub> from the infertile intermediate types. One group gave the two parental types plus infertile intermediates, and the other group produced the parental types plus both infertile end fertile intermediates, the same as the F<sub>2</sub> segregation\* those classed as fertile intermediates in F<sub>2</sub> segregated to produce two-rowed, fertile intermediate end six-rowed spike types\* The complete segregation ratio in F<sub>3</sub> far the two characters was as follows: - 4 true breeding two-rowed\*: segregating# two-rowed, infertile Intermediate, and six-rowed :4 segregating# tee-rowed, infertile intermediate, fertile intermediate, and six-rowed:2 segregating# two-rowed, fertile intermediate, and six-rowed:4 true breeding six-rowed\*

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## ABSTRACT

A cross was made of Glacier, a six-rowed variety, with Compana, a two-rowed variety of barley. The  $F_3$  segregation for spike row character and lateral spikelet fertility is reported.

The two-rowed versus six-rowed character was found to be controlled by a single genetic factor pair. The segregation ratio was three non-six-rowed types to one six-rowed type.

Two intermediate spike types were found in  $F_2$ , some having infertile lateral spikelets, and others had some seed set in the laterals. These appeared in  $F_2$  in a ratio of three infertile to one fertile. There were two types of segregations observed in  $F_3$  from the infertile intermediate types. One group gave the two parental types plus infertile intermediates, and the other group produced the parental types plus both infertile and fertile intermediates, the same as the  $F_2$  segregation. Those classed as fertile intermediates in  $F_2$  segregated to produce two-rowed, fertile intermediate and six-rowed spike types.

The complete segregation ratio in  $F_3$  for the two characters was as follows: - 4 true breeding two-rowed:2 segregating; two-rowed, infertile intermediate, and six-rowed:4 segregating; two-rowed, infertile intermediate, fertile intermediate, and six-rowed:2 segregating; two-rowed, fertile intermediate, and six-rowed:4 true breeding six-rowed.

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INTRODUCTION

Barley is an important cereal crop in Montana and in the United States. There was a greatly increased demand for the grain during World War II, both as a feed for an accelerated livestock production program and as a source of ethyl alcohol. In general, this demand was met. There is still a need for well adapted, high producing, disease resistant varieties of barley in many areas of the State and Nation.

Genetic principles are invaluable to plant breeders in their efforts to develop superior varieties, not only in barley but in all crop plants. In both the six-rowed barleys, Hordeum vulgare L., and the two-rowed types, H. distichum L., there are seven pairs of chromosomes. This relatively small number is advantageous in inheritance studies.

Plants of the genus Hordeum are normally self-pollinated and intra- and inter-specific crosses are easily made. At each node of the rachis there are three single-flowered spikelets. The fertility of the two lateral spikelets is the principal factor used in differentiating the species H. vulgare and H. distichum. The mode of inheritance of lateral spikelet fertility when varieties of these two species are crossed has been studied by a large number of investigators with results varying with the parent material used.

In this paper the  $F_3$  segregation of a cross of a six-rowed variety, Glacier, and a two-rowed variety, Compans, is reported and this segregation is interpreted in terms of the genetic factors involved.

## REVIEW OF LITERATURE

The mode of inheritance of the two-rowed versus six-rowed character has been studied by numerous workers whose researches have extended over a period of more than half a century. Daane (3) <sup>1/</sup> in 1931 and Leonard (12) in 1942 have summarized the literature on the character and they report all investigators as having found a single factor difference between these two types. However, the fertility of the intermediate types and the breeding behavior of these forms has not been constant. Previous workers have been at wide variance in their explanations of the type of segregation which they observed.

Biffen (1) in 1906 reported that in several crosses involving six-rowed and non-six-rowed types, a ratio of 3:1 resulted in all cases, with the less fertile type being dominant. In no case did he observe any lateral spikelet fertility in the  $F_1$ . Griffee (8) in 1925 reported a single factor difference for two- versus six-rowed type but made no mention of lateral spikelet fertility. Daane (3) reported that Neathy, McGregor and Buckley also found the segregation to be governed by a single factor pair. Hor (11) in 1924 made no mention of any fertility factors in his study but merely gave an observed ratio of 3:1 for non-six-rowed versus six-rowed type. Tedin and Tedin (17) in 1929 reported only a single factor difference between the two- and six-rowed character. They tried to explain this variance with that of von Ubisch's work of 1916 on the basis of a different method of classification.

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<sup>1/</sup> Numbers in parentheses refer to literature cited on page 25.

Other investigators have studied the fertility of the lateral spikelets in the intermediate types. Gillis (7) in 1926 reported that von Ubisch in 1916 found a fixed intermedium in the segregating population from a cross of H. distichum with H. vulgare. Von Ubisch explained this on the basis of a second factor which, in the recessive condition, produced fertile lateral spikelets in the absence of the factor producing the normal six-rowed type.

Harlan and Hayes (9) in 1920 also obtained a fixed intermedium from a similar cross. They concluded that a second factor produced this intermediate type but they differed from von Ubisch in that they regarded the six-rowed type to be dominant over non-six-rowed types instead of recessive. Robertson (14, 15) in 1929 and 1933 reported similar results. Engledow (6) in 1924 obtained no fixed intermedium in a cross of two-rowed with six-rowed, and reported that a single factor pair differentiated the two. He suggested that variance of his results from those of Harlan and Hayes (9) was probably attributable to a different genetic constitution of the parents used.

Tedin (18) in 1929 found a fixed intermedium in a cross of H. subdeficiens x H. tetrastichum. He had considerable difficulty in classifying the non-six-rowed types and presumed numerous other factors to be operating. He concluded that the factor Zz for two- versus six-rowed, in the homozygous recessive condition always produced a six-rowed type, whereas the heterozygous and homozygous dominant condition both varied in degree of fertility. A second factor ww for fertility of the laterals would increase fertility in the presence of ZZ or Zz whereas WW would decrease the fertility. A third factor Tt in the dominant condition would increase the size of lateral florets and the recessive allele tt would decrease their size. In ZZww,

tt seemed to decrease lateral spikelet fertility, and Zz ww TT closely resembled zz -----, the true breeding six-rowed types. He concluded that in addition to these three factors, other factors may have been operating, which further complicated the classification.

Wexelsen (19) in 1924 noted differences in fertility but made no explanation of the genetic factors involved in producing infertile and fertile intermediate types.

Biffen (2) in 1907 found that in the  $F_2$  progeny of a two-rowed strain crossed with a six-rowed type there were some fertile intermediates while others were awn-pointed but sterile. All intermediate types segregated in  $F_3$  for two-rowed, fertile intermediate, and six-rowed with no difference between those classed in the  $F_2$  as having set seed in the lateral florets and those that did not set seed in the lateral florets.

Gillis (7) found, in the progeny of a cross of two- with six-rowed barley, two types of intermediates, neither of which bred true; that is, there was no fixed intermedium. One of these intermediate types had highly fertile lateral spikelets with short awns, the other type had enlarged, awnless, lateral florets which were mostly sterile or of very low fertility. The  $F_2$  segregation was 1:3:6:4 for two-rowed, low fertility intermediates, highly fertile intermediates, and six-rowed. In his factorial analysis however, he agreed with von Uebisch that there were two factors operating, one of which should have produced a fixed intermedium. He noted that from one of his heterozygous  $F_2$  types, no six-rowed plants were obtained in  $F_3$  and from another heterozygous type, no two-rowed plants were found. According to his hypothesis, the factor ww for awnless, low fertility lateral

spikelets or in heterozygous condition  $Ww$  decreased the number of two-rowed types which should be produced by  $ZZ$ , the factor necessary for normal two-rowed development.  $ZZWw$  would have some fertility and  $ZZww$  should be a true breeding, low-fertility, awnless intermediate, which would correspond to the fixed intermediate obtained by Harlan and Hayes (9). From  $F_2$  plants which were of the genotype  $ZZWw$  the following  $F_3$  types would result: two-rowed; heterozygous; low-fertility, awnless intermediates.  $Zsww$  would appear as a low-fertility, awnless intermediate and in  $F_3$  would give six-rowed, heterozygous, and fixed intermediate types.

Hor (11) concluded that the factors for deficiens, distichon, and vulgare spike types formed an alleomorphic series with the least fertile being dominant. Engledow (6) maintained that the intermediate and low fertility of lateral spikelets were not members of this group. Leonard (12) concluded that there was an allelic series for fertile intermediate, infertile intermediate and non-intermediate, and he supports Harlan & Martini (10) who in 1935 concluded that since the infertile intermediate phenotypically resembles the distichum, many varieties thought to be H. distichum may be the intermediate type with infertile factors.

It has long been recognized by geneticists that the environment affects the expression of the character for lateral spikelet fertility. Biffen (2) in 1907 noted that when plants were more widely spaced the fertility was higher. Engledow (6) in 1924 demonstrated the effect of plant spacing and soil moisture condition on lateral spikelet development. Harlan and Martini (10) and Leonard (12) also noted this effect, with the later tillers and end-of-row plants producing more seeds in the lateral spikelets.

There are numerous conjectures that other factors may indirectly influence fertility. Engledow (5) in 1921 suggested that a factor inhibiting awn development might decrease fertility. He also thought perhaps the lateral florets were too small to permit seed development or that maybe a different vascular supply to the laterals might have some effect. He recommended that more detailed cytological and morphological studies be made to determine the cause, rather than for investigators to continue with mere eye observations of the result. Robertson (14) cites Veideman as reporting that there was no gene for fertility but that differences were governed by the anatomical structure and function of the pedicel. Most investigators seem to feel that there is still much to be learned from studying segregation in barley crosses, and interpreting results in terms of Mendelian principles.

## MATERIALS AND METHODS

The varieties involved in the cross are Glacier, C. I. <sup>2/</sup> 6976 and Compana, C. I. 5638. Glacier is described by Litzenger (13) as a six-rowed, semi-smooth-awned, white seeded and hulled variety. It is a selection from the fifth generation of a cross of Atlas and Vaughn. He described Compana as a two-rowed, semi-smooth-awned, white seeded and hulled variety. It is a selection from the tenth generation of a composite of 32 different crosses designated as composite cross C. I. 4116. Both Glacier and Compana are recommended barley varieties for production in Montana. Glacier is recommended under irrigable conditions and in the more humid areas, while Compana is recommended for the dry-land area of the State.

The Glacier x Compana cross was made in 1942 by Mr. S. C. Litzenger as a part of the barley breeding program at Montana Agricultural Experiment Station at Bozeman, Montana. The aim in making the cross was to incorporate the loose smut (Ustilago nuda) resistance of Compana into a Glacier type and to obtain a Compana type with the stiffness of straw of Glacier.

The  $F_1$  plants from the two crossed seeds obtained were grown in 1943 and were described as having spikes with fertile central spikelets with long semi-smooth awns, whereas the lateral spikelets were sterile but awn-pointed. These latter types are called intermediates. These differ from another type, called intermedium, having fertile lateral spikelets which are reduced in size and have rounded lemma tips. The spike types obtained in this study are shown in Figure 1.

A population of 370  $F_2$  plants were grown in 1944 in nursery rows with approximately 3 inches between plants. These plants were pulled when mature

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<sup>2/</sup> C. I. refers to Bureau of Plant Industry accession number.

and classified in the laboratory by Davis (4) according to the lateral spikelet development. The following classes were made: two-rowed, infertile intermediate, fertile intermediate, and six-rowed.

Approximately 100 seeds from each of these  $F_2$  plants were space planted in family rows in 1945. These families were then classified according to their segregation for lateral spikelet fertility. Five classes were made as follows:- true breeding two-rowed: segregating; two-rowed, infertile intermediate, and six-rowed: segregating; two-rowed, infertile intermediate, fertile intermediate and six-rowed: segregating; two-rowed, fertile intermediate and six-rowed: and, true breeding six-rowed.

The chi-square ( $X^2$ ) test was used to measure goodness of fit of observed to expected ratios.



Figure 1. Spike types obtained from a cross of Glacier with Compans barley:  
1 True two-rowed (Compans) type. 2 Two-rowed type with enlarged lateral florets. 3 Infertile intermediate. 4 Fertile intermediate. 5 True six-rowed (Glacier) type.

## EXPERIMENTAL RESULTS

Three hundred-seventy  $F_2$  plants were classified as follows: 35 true breeding two-rowed, 151 infertile intermediate, 37 fertile intermediate, and 97 true breeding six-rowed plants. The 100 plant progenies of 323 of these  $F_2$  individuals are reported in the following sections.

 $F_3$  Classification

The  $F_3$  breeding behavior of 323  $F_2$  plants is given in Table 1. These  $F_3$  families were classified in five classes with the following frequencies: 83 true breeding two-rowed; 36 segregating for two-rowed, infertile intermediate, and six-rowed; 76 segregating for two-rowed, infertile intermediate, fertile intermediate, and six-rowed; 43 segregating for two-rowed, fertile intermediate and six-rowed; and 90 true breeding six-rowed. Progenies from three plants classified as two-rowed in  $F_2$  were found to segregate in  $F_3$ , and progenies from two other plants classified in  $F_2$  as infertile intermediate were found to be true-breeding two-rowed in  $F_3$ . The reported classification has been corrected to include these changes.

Table 1.  $F_3$  Classification of 323 Families of Glacier x Compans Barley on the Basis of Lateral Spikelet Fertility

| Class No. | Class Description                                                                 | Number of Families |
|-----------|-----------------------------------------------------------------------------------|--------------------|
| 1         | True breeding two-rowed                                                           | 83                 |
| 2         | Segregating; two-rowed, infertile intermediates, six-rowed                        | 36                 |
| 3         | Segregating; two-rowed, infertile intermediates, fertile intermediates, six-rowed | 76                 |
| 4         | Segregating; two-rowed, fertile intermediates, six-rowed                          | 43                 |
| 5         | True breeding six-rowed                                                           | 90                 |
| Total     |                                                                                   | 328                |

Two-rowed versus Six-rowed

On the basis of previous work presented in the above Literature Review Section a single factor difference which gives a ratio of 1 two-rowed; 2 intermediate; 1 six-rowed is expected. The actual segregation in this population was 83:155:90. When the chi-square test was applied to these data a  $\chi^2$  of 1.2866 was obtained as reported in Table II with a corresponding P value of .50. This indicates a satisfactory fit to the expected 1:2:1 ratio. This head type factor for two-rowed versus six-rowed has been designated by Robertson, et al. (16) in 1941 as Vv, with VV producing two-rowed, Vv intermediate and vv six-rowed types.

Table II. Calculation of Goodness of Fit to an Expected 1:2:1 Segregation Ratio for Two-Rowed; Intermediate; Six-Rowed Spike Type from classified  $F_3$  Families of Glacier x Compans Barley.

| Phenotype    | Observed Number | Calculated Number | $\frac{(O-C)^2}{C}$ |
|--------------|-----------------|-------------------|---------------------|
| Two-rowed    | 83              | 82                | 0.0122              |
| Intermediate | 155             | 164               | 0.4939              |
| Six-rowed    | 90              | 82                | 0.7805              |
|              | <u>328</u>      | <u>328</u>        | <u>1.2866</u>       |

$$\chi^2 = 1.2866$$

$$P = .70 - .50$$

## Fertility of Lateral Spikelets

When the fertility of the 155 intermediates of the above segregating families is considered separately, a distribution of 36:76:43 for infertile, infertile plus fertile, and fertile is obtained. In Table III is given the chi-square test for the goodness of fit to a 1:2:1 ratio. A probability of .70 indicates

a very close fit. This segregation is explained on the basis of a single factor controlling the fertility of the lateral spikelets in the intermediate types. This factor has been designated by Davis (4) as  $I_1i_1$  with the infertility being dominant.

Table III. Calculation of Goodness of Fit to an Expected 1:2:1 Segregation Ratio For Fertility of Lateral Spikelets in  $F_3$  from  $F_2$ 's of Glacier x Compans Barley Having Intermediate Spike Types.

| $F_2$<br>Phenotype | $F_3$<br>Breeding<br>Behavior | $F_2$<br>Genotype | Observed<br>Number | Calculated<br>Number | $\frac{(O-C)^2}{C}$ |
|--------------------|-------------------------------|-------------------|--------------------|----------------------|---------------------|
| Infertile          | Infertile                     | $I_1I_1$          | 36                 | 38.75                | 0.1982              |
| Infertile          | 3 Infertile<br>1 Fertile      | $I_1i_1$          | 76                 | 77.50                | 0.0290              |
| Fertile            | Fertile                       | $i_1i_1$          | 43                 | 38.75                | 0.4661              |
| Total              |                               |                   | 155                | 155.00               | 0.6933              |

$$\chi^2 = 0.6903$$

$$P = .70$$

When the entire population is considered for both characters as given in Table I, a ratio of 4:2:4:2:4 is approximated. Table IV gives the chi-square test for goodness of fit of the data to this ratio. That there is no large discrepancy between the expected and observed numbers is indicated by a P value of .60. This ratio is explained on the basis of two factors Vv and  $I_1i_1$  operating with Vv controlling the row character and  $I_1i_1$  determining the fertility of lateral spikelets in the intermediate types. Assuming VV and vv to be epistatic to  $I_1i_1$ , then  $I_1i_1$  would therefore

be expressed only in the presence of Vv. This would account for the ratio obtained.

Table IV. Calculation of Goodness of Fit to a 4:2:4:2:4 Segregation Ratio for Spike Type and Fertility in  $F_3$  of Glacier x Compana barley.

| Phenotype                                                                      | Observed<br>Number | Calculated<br>Number | $\frac{(O-C)^2}{C}$ |
|--------------------------------------------------------------------------------|--------------------|----------------------|---------------------|
| Two-rowed                                                                      | 85                 | 82                   | 0.0122              |
| Seg.; two-rowed, infertile<br>intermediates, six-rowed                         | 36                 | 41                   | 0.6098              |
| Seg.; two-rowed, infertile<br>intermediate, fertile intermediate,<br>six-rowed | 76                 | 82                   | 0.4390              |
| Seg.; two-rowed, fertile intermediate,<br>six-rowed                            | 43                 | 41                   | 0.0976              |
| Six-rowed                                                                      | 90                 | 82                   | 0.7805              |
| Total                                                                          | 328                | 328                  | 1.9391              |

$$\chi^2 = 1.9391$$

$$P = .90 - .80$$

A complete analysis of the segregation in  $F_3$  along with  $F_2$  phenotypes and genotypes is given in Table V which presents the results of this study in tabular form.

Table V.  $F_2$  Phenotypes and Genotypes and  $F_3$  Breeding Behavior for Fertility of Lateral Spikelets of 328 Families of Glacier x Compana Barley

| $F_2$<br>Phenotype | $F_2$<br>Phenotypic<br>Ratio | $F_2$<br>Genotype               | $F_2$<br>Gene-<br>typic<br>Ratio | $F_3$<br>Breeding<br>Behavior                               | $F_3$<br>Segregation<br>Ratio | $F_3$<br>Families,<br>Observed<br>Number |
|--------------------|------------------------------|---------------------------------|----------------------------------|-------------------------------------------------------------|-------------------------------|------------------------------------------|
| Two-rowed )        | 4                            | VVI <sub>1</sub> I <sub>1</sub> | 1                                | True Breeding Two-rowed )                                   | 4                             | 83                                       |
| Two-rowed )        |                              | VVI <sub>1</sub> i <sub>1</sub> | 2                                | True Breeding Two-rowed )                                   |                               |                                          |
| Two-rowed )        |                              | VVi <sub>1</sub> i <sub>1</sub> | 1                                | True Breeding Two-rowed )                                   |                               |                                          |
| Infertile )        | 6                            | VvI <sub>1</sub> I <sub>1</sub> | 2                                | Seg., 1 Two-rowed: 2 Infertile                              | 2                             | 36                                       |
| Intermediate )     |                              |                                 |                                  | Intermediate: 1 Six-rowed                                   |                               |                                          |
| Infertile )        |                              | VvI <sub>1</sub> i <sub>1</sub> | 4                                | Seg., 4 Two-rowed: 6 Infertile                              | 4                             | 76                                       |
| Intermediate )     |                              |                                 |                                  | Intermediate: 2 Fertile Inter-<br>mediate: 4 Six-rowed      |                               |                                          |
| Fertile )          | 2                            | VvI <sub>1</sub> i <sub>1</sub> | 2                                | Seg., 1 Two-rowed: 2 Fertile In-<br>termediate: 1 Six-rowed | 2                             | 43                                       |
| Intermediate )     |                              |                                 |                                  |                                                             |                               |                                          |
| Six-rowed )        | 4                            | vvI <sub>1</sub> I <sub>1</sub> | 1                                | True Breeding Six-rowed )                                   | 4                             | 90                                       |
| Six-rowed )        |                              | vvI <sub>1</sub> i <sub>1</sub> | 2                                | True Breeding Six-rowed )                                   |                               |                                          |
| Six-rowed )        |                              | vvi <sub>1</sub> i <sub>1</sub> | 1                                | True Breeding Six-rowed )                                   |                               |                                          |
| Total              |                              |                                 |                                  |                                                             |                               | 328                                      |

## DISCUSSION

Little difficulty was experienced in classifying the  $F_3$  lines except for a few plant rows which were badly lodged. In these cases the recognized effect of environment was considered in making final classification. The shape of lemma tips of the lateral spikelets was used in distinguishing the two-rowed type from the infertile intermediate type. The lemma tips were rounded on the two-rowed types and on the infertile intermediates they were awn-pointed or had awns up to 1.5 cm. in length. In most cases the lateral spikelets were larger on the infertile intermediate plants than on the true breeding two-rowed plants, but none were fertile. Those classed as fertile intermediates varied in the amount of fertility of the lateral spikelets. Some plants of this class had only a few fertile lateral spikelets while others were nearly completely fertile. The awns from the fertile lateral lemmas were greatly reduced in length as compared with those on the lemmas on the central spikelets.

For those plants which were badly lodged, the recognized effect of environment was considered in making final classification. A few plants of special interest were grown to check the segregation.

One fertile intermediate plant found in a family which was otherwise breeding true for the two-rowed character was found to segregate as follows: two-rowed; fertile intermediate; and six-rowed. It was probably a natural hybrid or a mechanical mixture, since as pointed out above, it was the only plant in the family not breeding true for the two-rowed type.

A single fertile intermediate plant was found in a family which segregated 1:2:1 for two-rowed: infertile intermediate: six-rowed. In  $F_4$  this

plant segregated the same as the parent line, indicating that some factor other than those studied might have produced the few fertile lateral spikelets found on this plant, since it did not segregate as did other plants in the study classified as fertile intermediates.

In another family segregating for two-rowed, infertile intermediate and six-rowed in a ratio of 1:2:1, a plant was found which had very low fertility in the central spikelets and with very poorly developed lateral spikelets, a few of which were fertile. In  $F_4$  this plant produced only six-rowed plants. Some environmental factor probably arrested development of this  $F_3$  plant in the flowering stage.

A family segregating for two-rowed, fertile intermediate and six-rowed types was found to contain two plants which had no fertile lateral spikelets. However, when seeds from these plants were planted, the  $F_4$  segregation was the same as the parent family. Again environment must have affected the lateral spikelet fertility of these plants because they were no different genetically from the fertile intermediates in the family, even though there were no fertile lateral spikelets in  $F_3$ .

Other examples of apparent field hybrids or mechanical mixtures were found in each of two families otherwise true-breeding for the six-rowed type. In one case an infertile intermediate plant was found which segregated in  $F_4$  to produce two-rowed, infertile intermediate, and six-rowed plants. In the other example, a fertile intermediate was found which segregated in  $F_4$  to give the expected 1:2:1 ratio of two-rowed: fertile intermediate:six-rowed. It is highly probable that these are not the result of genetic factors within the families since all other plants classified as six-

rowed in  $F_2$  bred true in  $F_3$ .

As nearly as could be determined, the segregation obtained in this study has not been reported previously. The segregation for six-rowed versus non-six-rowed types in this study is in agreement with other investigators' works, but the mode of inheritance of fertility in intermediate types differs from that recorded in the literature reviewed.

Since none of the intermediate classes was true breeding, the results cannot be explained on the basis of the factors reported by Earlan and Hayes (9). Tedin (18) also found a fixed intermedium, which was not found in this study. He reported a third factor which influenced the size and fertility of lateral spikelets which might possibly have operated similarly to the second factor in this cross, had the segregation from his cross not been further complicated by the fertile intermedium factor.

Biffen (2) found some infertile and some fertile intermediates in the  $F_2$  of a cross of a two-rowed strain with a six-rowed type. However, both of those types segregated alike in  $F_3$ .

In a similar cross, Gillis (7) found two types of intermediates in  $F_2$ , neither of which bred true in  $F_3$ . From some of his heterozygous plants, he did not obtain both parental types in  $F_3$ . In this study, all intermediate types segregated to produce both the two-rowed and the six-rowed parental types. Therefore, the genetic constitution of the parents he used must have differed from the Compans and Glacier used in this cross.

Compans, the two-rowed parent carried the VV factor into this cross, and Glacier, the six-rowed parent carried the allele vv. In the time allotted to this study, it has been impossible to determine which parent carried the

factor for infertile intermediate,  $I_1 I_1$ , and which the recessive allele.

By backcrossing a fertile intermediate and an infertile intermediate from a family segregating for two-rowed, infertile intermediate, and six-rowed types to both parents, it should be possible to determine the parental genotypes. This program has been initiated.

## SUMMARY

The segregation in  $F_3$  for spike row character and lateral spikelet fertility of a cross of Glacier, a six-rowed variety, with Compana, a two-rowed variety of barley is reported.

The two-rowed versus six-rowed character was found to be simply inherited with a single factor pair designated as Vv differentiating the two types. The dominant condition produced the two-rowed type, and the six-rowed type was produced by the recessive condition, and the heterozygous condition produced intermediate types.

Two types of intermediates were found in  $F_2$ . In one group the lateral spikelets were sterile, and in the second group there was some seed set in the lateral spikelets. The fertility of the lateral spikelets of these intermediates was also found to be controlled by a single factor pair. This second factor has been designated as  $I_1i_1$ . This character was expressed only when the factor for row character was in the heterozygous condition, Vv. In  $F_2$  the genotypes,  $I_1I_1$  and  $I_1i_1$  produced infertile intermediates, and  $i_1i_1$  produced fertile intermediates. The ratio was 3 infertile:1 fertile.

When the two factor pairs were considered together, the segregation ratio was as follows:

- 4 True breeding two-rowed.
- 2 Segregating, 1 two-rowed:2 infertile intermediate:1 six-rowed.
- 4 Segregating, 4 two-rowed:6 infertile intermediate:2 fertile intermediate:4 six-rowed.
- 2 Segregating, 1 two-rowed:2 fertile intermediate:1 six-rowed.
- 4 True breeding six-rowed.

As nearly as could be determined this segregation ratio for fertility in lateral spikelets of a cross of a two-rowed barley variety with a six-rowed variety has not previously been reported.

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