INHERITANCE OF GLIADIN COMPOSITION IN BREAD WHEAT, TRITICUM AESTIVUM L.*

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SUMMARY

The gliadin compositions of 101 selected lines from 2 crosses between varieties of *T. aestivum* were examined by applying starch-gel electrophoresis at pH 3.1. The gliadin patterns of these lines were recognized to be composed of sections of the parental patterns. In a wheat variety the gliadin pattern proved to be divisible into 6 or 7 sections, the configurations of which are inherited unaltered. Its gliadin composition, consequently, is determined by at least 6 genetic factors. The sections appeared to be identical to the gliadin fractions currently known as α, β, γ, and ω; the β gliadin proved to consist of 2 sub-fractions and the ω gliadin of 2 or 3 sub-fractions.

INTRODUCTION

Up to now the comparative study of wheat varieties (*T. aestivum* L.) by gel electrophoresis of the endosperm protein has disclosed the following:

- Several varieties within the species *T. aestivum* show similar electrophoretic patterns of albumins and globulins, but they may differ very much in gliadin pattern. This has been established by electrophoresis of protein extracts in starch gels (ELTON and EWART, 1962; BOURDET et al., 1963; COULSON and SIM, 1964; HUEBNER and ROTHFUS, 1968; DOEKES, 1968), in polyacrylamide gels (NIMMO et al., 1963; LEE and WRIGHT, 1963), and in agar gels (POPOFF and ILIEV, 1967).
- The gliadin pattern of the endosperm protein is governed by genetic factors only; it does not react to variations in the growing conditions of the wheat plant. As a consequence, it is also independent of variations in the protein content of the endosperm (LEE and WRIGHT, 1963; COULSON and SIM, 1964; LEE and RONALDS, 1967; FEILLET and BOURDET, 1967; DOEKES, 1968, 1969).
- Related varieties of *T. aestivum* may show similar gliadin patterns (LEE and WRIGHT, 1963; GRAHAM, 1963; DOEKES, 1968).

On account of these effects one might expect gliadin electrophoresis to provide also some information on the inheritance of gliadin compositions from parent varieties to the offsprings. We studied this question in a number of offsprings from 2 crosses of *T. aestivum* varieties.

* Dedicated to Professor Dr H. Veldstra on the occasion of his retirement from the chair of biochemistry of the University of Leiden.
GLIADIN COMPOSITION IN WHEAT

MATERIALS AND METHODS

The materials, kindly provided by the Foundation for Agricultural Plant Breeding at Wageningen, comprised (a) samples of 40 selected lines from the progeny of the cross 5937 = Jufy I × Thatchér, and (b) samples of 61 selected lines from the progeny of the cross 6154 = Roemer 7666/37 × (H.10 × Heine 13119). The selected lines were all F10's. In the F5, selection was carried out for the biggest ears, and in the F6 through the F10 for firmness of the stems; this procedure reduced both original populations by about 40%.

Five grams of kernels were ground on a cone grinder (MIAG, Brunswick, W-Germany); the meal was suspended into 15 ml 40% ethanol with the aid of a Potter-Elvehjém homogenizer, during 2 min at room temperature. The suspension was centrifuged for 15 min at 30000 g and 15°C. Urea was added up to 3M to the clear protein solution, in order to prevent precipitation of protein. Any dissolved amylase, which attacks the starch gel during electrophoresis, was inactivated by heating the protein solution to 80°C and cooling it immediately in running tap water.

The preparation of starch gels with aluminium lactate buffer (pH 3.1), the method of electrophoresis, and the staining of the protein bands in the gels were carried out as described before (DOEKES, 1968). Electrophoresis was performed in a cold room (3°C) at 15V/cm and about 30 mA, during 160 min. Densitograms were made of the protein tracks by means of a densitometer (Vitatron, Dieren, the Netherlands). In order to recognize the same protein component in different densitograms, a reference system was used in which the place of each component was indicated as a percentage of the total length of the protein pattern. In this system of Rv values the gliadin components lie between Rv = 0 (the starting point of electrophoresis) and 31 (DOEKES, 1968).

RESULTS AND DISCUSSION

Among the offsprings from the cross 5937 = Jufy I × Thatchér, some showed the complete gliadin pattern of either Jufy I or Thatchér. This confirms earlier observations that related varieties of T. aestivum can have similar gliadin compositions (see Introduction). The gliadin patterns of all the other offspring lines, however, appeared to be composed of sections which figured recognizably in either one or the other parental pattern. Fig. 1 shows some examples.

According to Fig. 1, sections of the gliadin pattern may have boundaries at the values Rv 8 (in the selected lines 5937-5 and -22), Rv 11 (in -54), Rv 16.5 (in -54), Rv 19 (in -22 and -66), and Rv 23 (in -22 and -54). The same section boundary, therefore, may occur in more than one selected line. Examination of all the 40 selected lines from the 5937 cross showed that boundaries of gliadin sections occurred only at these 5 Rv values. Table 1 illustrates this. These results strongly suggest that the complete gliadin pattern of a selected line of wheat is composed of sections that are each inherited unaltered from one of the parent varieties. It follows from Table 1 that the boundaries between these sections have their mean positions at Rv, 8, 11.5, 16.5, 19, and 23.

Effects of the same kind were observed in the progeny of the cross 6154 = Roemer 7666/37 × (H.10 × Heine 13119). Some examples are shown in Fig. 2. According to