

Changes in the occurrence of *Avena fatua* L. in fields in south-eastern Poland

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Abstract

Studies on changes in the occurrence of *Avena fatua* L. and its varieties on arable land were carried out in 1990, 1994 and 1995. Strong expansion of the species was found. In 1990, 12 stations where *A. fatua* occurred with intensity above 1% were recorded, in 1994, 29 such stations were found, and 67 stations in 1995. Varieties A and F were most frequent, and variety E occurred in the lowest numbers. Dependence between the size of a population of a given variety and its geographical location were found.

INTRODUCTION

Avena fatua L., deriving from south-western Asia (Iranoturkish region) has spread to all continents (Hegi, 1965; Zajac, 1979). It is a very aggressive weed, posing a great threat to crops. It can reduce spring crop yields by up to 70% (Friesen, 1960; Bell & Nalewaja, 1968; Sharma & Van den Born, 1978; Ormeno, 1992; Babalola et al., 1993) and winter crop yields by 40% (Kapeluszny, 1981). In Europe it ranks first in terms of the frequency of occurrence in spring crops, twelfth in winter crops and fifteenth in winter rape (Schroeder et al., 1993).

In Poland it spread widely in the 1960s in western and northern areas and in Lublin Province (Rola et al., 1981). In the 1970s it began to expand all over Poland, but its intensity was not high. It occurred throughout almost all of south-eastern Poland, but it did not pose a threat to arable land (Stupnicka-Rodzynekiewicz et al., 1981 a,b; Stupnicka-Rodzynekiewicz et al., 1986).

Since the end of the 1980s, probably due to the political and economic transformation in Poland which led to increased costs, reduced chemical control and the abandonment of cultivation in some fields, the frequency of *A. fatua* started to increase rapidly (Kieć, 1996, 1997). The similar phenomena has been observed in different regions of Poland (Borowiec et al., 1992; Hołdyński, 1991; Hołdyński & Korniak, 1987; Kapeluszy & Haliniarz, 1997; Korniak, 1987; Skrzyczyńska et al., 1996; Wnuk, 1996). This could also have resulted from increased resistance to *A. fatua* herbicides, a phenomenon which has occurred frequently in a number of countries (Mansooji et al., 1992; Devine et al., 1993; Holtum et al., 1994; O'Donovan et al., 1994), but which has not yet been reported in Poland.

There is much morphological variation found in *A. fatua* populations in south-eastern Poland (Kieć, 1995).

The study is aimed at determining changes in the range and intensity of occurrence of the *A. fatua* and its varieties in south-eastern Poland.

METHODOLOGY

In 1990, 1994 and 1995 the occurrence of *A. fatua* and its varieties were studied within a predetermined route, which has been designated at the beginning of study. The studies covered the southern part of the Kielce Province, the eastern part of Cracow Province, the western part of the Przemyśl and Krosno Provinces and the Provinces of Tarnów, Rzeszów and Nowy Sącz (Fig.1). Included in the studies were arable fields infested with *A. fatua* in more than 1% of the total plant stand. All plants of this weed were collected from 1 square meter (random designated) of each station in order to determine the percentages of particular varieties marked with working designations of A to J (Tab.1).

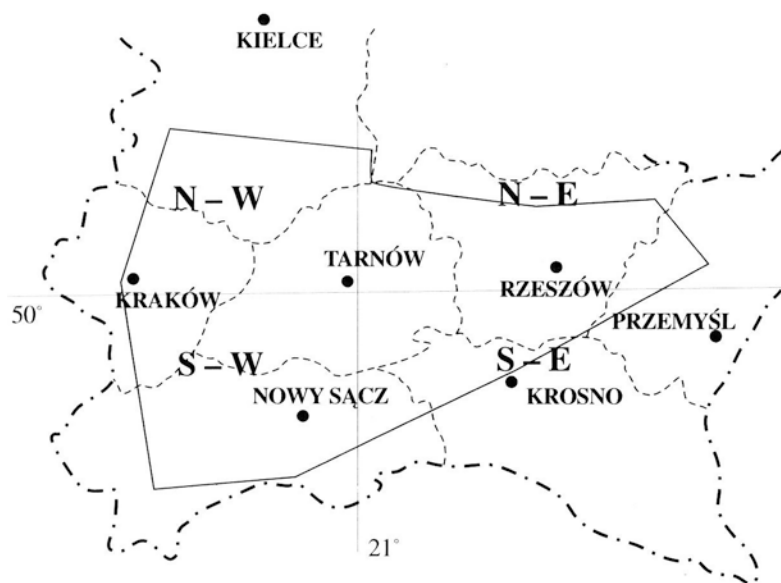
The study area was divided into four sectors, along the 21st meridian and the 50th parallel, to investigate whether there is any dependence between geographical location and the frequency of occurrence of specific varieties of *A. fatua*.

RESULTS

Very strong expansion of the *A. fatua* was found in the study area. In 1990 there were 12 stations with *A. fatua* coverage above 1%, while in 1994 there were 29 stations, and in 1995 as many as 67. It should be mentioned that the weed expanded most strongly in the southern parts of the provinces of Kielce, Nowy Sącz, Kraków and Tarnów, in the northern part of Rzeszów Province, and in the west of Przemyśl Province. The intensity of *A. fatua* occurrence also increased rapidly, at the beginning of the study the weed occurrence in most fields was classified as sporadic to average – coverage ratio fluctuated between values below 50 up to 500 (Koter et al., 1988), and in the last year it was from average to very high – coverage ratio between 500 and 1000. In different regions of Poland its invasion has begun earlier,

Table 1.
Short description of *A. fatua* varieties /Kieć, 1995/

Variety	Height of plants	Lemma/ Palea pubescens	Lemma/ Palea colour	Length of callus pubescens	Mass of 1000 grains
A – var. <i>fatua</i>	81,05	strong	bright to dark brown	long	15,5
B	81,31	strong	yellow to grey	long	13,0
C	92,73	weak	yellow to grey	long	11,1
D – var. <i>glabrata</i>	87,46	lack	yellow to grey	long	11,3
E	91,93	lack	bright to dark brown	long	12,8
F – var. <i>intermedia</i>	95,55	strong	bright to dark brown	short	15,9
G	98,97	strong	yellow to grey	short	13,9
H	89,95	weak	yellow to grey	short	15,7
I	96,69	weak	bright to dark brown	short	12,4
J – var. <i>villis</i>	80,35	lack	yellow to grey	short	11,9



— · — · — · — · – state border
- - - - - – province borders
N–W ... S. E. – sectors

for example in Żuławy Wiślane in the 1970s (Hołdyński, 1991), in central Poland on the beginning (Skarżyczyńska et al., 1996) and north-eastern part in the end of the 1980s (Korniak, 1987).

On average, variety A (17,2%) was most numerous in the study period (the least competitive versus spring barley – Kieć, 1996 – and it was not highly sensitive to diclofop-methyl and cycloate – Kieć, unpubl. obs.). Variety F (16%), was also very numerous: it rapidly decreased the weight per thousand grains of spring barley; and was rather sensitive to fenoxaprop-P-ethyl, diclofop-methyl, quizalofop-P-ethyl and cycloate (Table 2).

Variety E was least numerous (1,5%). The weed strongly affected spring barley yields and it was rather sensitive to all studied herbicides. Variety D (average competitive capability, average sensitivity to cycloate) showed a declining tendency, from 18,1% in 1990 to 3,3% in 1995. Varieties H (average competitive capability, low sensitivity to cycloate) and I (most reduced the weight of a thousand barley grains, with low sensitivity to cycloate) showed high expansion, from 0,0% in 1990 to 19,5% and 17,3% in 1995, respectively.

Table 2

Percentage of *Avena fatua* varieties in field weed infestation in South - East part of Poland

A. fatua varieties													
Year	with long callus pubescens						with short callus pubescens						Other
	A	B	C	D	E	Σ	F	G	H	I	J	Σ	
1990	21,1	4,3	13,0	18,1	2,3	58,8	30,1	0,9	0,0	0,0	8,2	39,2	2,0
1994	24,6	5,3	8,7	6,0	1,2	45,8	13,3	10,5	5,1	9,9	10,9	49,7	4,5
1995	13,4	3,9	8,3	3,3	1,5	30,4	14,7	12,1	19,5	17,3	2,4	66,0	3,6
Mean	17,2	4,3	9,0	5,7	1,5		16,0	10,4	13,6	13,4	5,2		3,7

The remaining varieties, i.e. B (weak competitive capability, low sensitivity to cycloate), C (strongly affecting barley yields and stalk formation), and J (low competitive capability, sensitive to all tested herbicides) showed fluctuations in population size, depending on the year. The results relative to the varieties frequency are different than obtained by other authors. Probably the main reason was that they studied only earlier described, four *A. fatua* botanical varieties (Hołdyński, 1991; Korniak, 1996).

Considering only varieties with long hair on the callus (A–E) a declining trend can be noted (from 58,8% in 1990 to 30,4% in 1995) in favour of varieties with short hair on the callus (F–J) which have longer stalks and higher weight calculated per thousand grains.

The study area was divided into sectors (Fig. 1). Analysis of the distributions of specific varieties in these sectors indicates that varieties A, C, F, G, H and I occurred in all sectors, but their number varied (Tab. 3).

Varieties B and E occurred in only one sector, north-western and north-eastern ones, respectively. The lowest diversification was found in south-eastern sector (only 6 varieties), and the highest occurred in the north-western one (9 varieties). The whole range of varieties did not occur in any sector.

Table 3
Percentage of *Avena fatua* varieties in sectors for studied years

Varieties	Sectors			
	N – W	N – E	S – W	S – E
A	21,79	0,65	11,64	4,95
B	10,47	–	–	–
C	13,73	2,51	6,16	4,63
D	7,31	–	1,34	–
E	–	11,11	–	–
Sum of var. with long callus pubescens	53,30	14,27	19,14	9,58
F	5,56	24,41	18,75	20,76
G	8,58	12,47	16,46	5,55
H	17,16	14,35	23,72	17,16
I	9,21	12,58	20,43	44,36
J	1,23	9,66	1,64	–
Sum of var. with short callus pubescens	41,74	73,47	81,00	87,83
Other	4,92	12,22	–	2,56

Variety A was the most numerous in the north-western sector, variety F in north-eastern sector, variety H in south-western sector and variety I in the south-eastern one.

Considering all the varieties with long-hair callus, it could be noted that their number decreased towards the east and west, and quantities of short-hair varieties increased.

CONCLUSIONS

1. The threat to arable land posed by the *A. fatua* is increasing.
2. Varieties A and F were the most numerous, and variety E occurred in the lowest number.
3. Varieties H and I were the most expansive, while variety D demonstrated a declining tendency.
4. Varieties with long-hair callus were replaced by short-hair ones, which due to their structure (larger size) could pose a greater threat to cultivars.
5. Clear dependence between the numbers of various varieties and their geographical locations were found; the farther south and east, the greater the number of short-hair callus varieties, including variety I.

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Streszczenie

W latach 1990, 1994 i 1995 na obszarze Polski południowo-wschodniej prowadzone były badania dotyczące zmian w występowaniu *Avena fatua* L. i jego odmian na polach uprawnych. Stwierdzono bardzo silną ekspansję tej rośliny. W roku 1990 znaleziono 12 stanowisk gdzie owies głuchy występował w nasileniu większym od 1%, w roku 1994 – 29 a w 1995 aż 67. Najliczniej występowały odmiany A i F, a najrzadziej E. Stwierdzono również zależność liczebności odmian od położenia geograficznego.