Autotetraploid stocks and the relationship between earliness and fertility. W. Friedt, Department of Plant Genetics of the Gesellschaft für Strahlen- und Umweltforschung mbH., 8059 Grünbach, FRG.

The collection of autotetraploid barley stocks and their corresponding diploids was grown in the field at Grünbach in 1977 and different morphological characters have been recorded as in previous years (see BGN 1, 1971; BGN 4, 1974; BGN 6, 1976; BGN 7, 1977). In addition to the stocks described before, new autotetraploids of the barley varieties and stocks listed in Table 1 have been induced. Limited amounts of seed of all of the autotetraploid stocks are available.

In a study of the different components of fertility of autotetraploid barley, the effect of earliness (heading date) on the seed setting was also investigated. Therefore, the seed set of all the stocks in the collection were recorded as given in BGN 7, 1977, Table 1, and the frequencies of stocks at the different dates in June and July were calculated. The resulting frequency-distributions are presented in the lower part of Fig. 1 for diploids and autotetraploids. Heading of diploids as well as of tetraploids started at June 10. The latest diploids headed at June 29, the latest tetraploids at July 3. Furthermore, it can be seen from Fig. 1 that 85% of the diploid varieties headed before June 23, but only 43% of the autotetraploids. Therefore, about one half of the tetraploids started heading, when almost all of the diploids had even finished it. Nevertheless, it is evident from Fig. 1 that early autotetraploid stocks do exist which could be used in breeding programs. In the upper part of Fig. 1 the average seed set of all stocks at their respective heading dates are drawn. It is evident that the seed setting is completely independent from the heading date in diploids but not in tetraploids. In the latter a significant negative correlation exists between heading date (lateness) and the average seed set at the respective date. It is therefore a precondition for the development of fertile tetraploid barley to use early stocks in breeding programs.

There is no doubt that the late heading of the tetraploids is a result of their retarded development which is obviously a general phenomenon in induced polyploids. Consequently, sporogenesis and fertilization of late types may occur in days with unfavourable high temperatures which possibly cause irregularities in gamete formation and fertilization.

In this context it is interesting to note, that tetraploids are obviously more susceptible to extreme temperatures than diploids. In Table 2 the seed set of two autotetraploid stocks and their corresponding diploids at different temperature-regimes are compared. The results indicate a smaller temperature optimum (ca. 14°C) for the tetraploids than for the diploids. It might be concluded, therefore, that meiosis and fertilization in tetraploids which is disturbed per se may in addition be more susceptible to extreme environmental conditions.

Table 1. Recently induced autotetraploid stocks of barley.

Original form Commercial variety (v) Breeders strain (s) Induced mutant (m) Wild type (w)	Brief description of the original diploid barley form
Aramir (v)	2-rowed, high-yielding (Netherlands)
Ortolan (v)	2-rowed, high-yielding (West Germany)
Kristina (v)	2-rowed, high-yielding (Sweden)
224/1328 (s)	2-rowed, high-yielding
302/1807 (s)	2-rowed, plump grain, high-yielding
548/1717 (s)	2-rowed, naked, plump grain
592/1839 (s)	2-rowed, high-yielding
681/1862 (s)	2-rowed, awn-less
MGH 6445 (s)	2-rowed, semi-dwarf (Netherlands)
Milln 140/38 (s)	2-rowed, semi-dwarf (Great Britain)
216/1323 (s)	2-rowed, black lemma & pericarp (B)
Nudinka (s)	2-rowed, naked, high-yielding (from Dr.E.Ulonska)
grsp. 5 (m)	2-rowed, short-awned (out of 'Haisa II')
MRM 52 (m)	2-rowed, mildew-resistant (out of 'Matura')
Hiproly (w)	2-rowed, dense spike, high lysine
Ubamer baco (w)	2-rowed, naked (Ethiopia)
Dissa (v)	4-rowed, high-yielding (West Germany)

Table 2. Seed set of two diploid and corresponding autotetraploid barley stocks in the greenhouse and at different temperatures in climate chambers.

Material	Greenhouse			Climate - chamber								
	22 ± 2°C[d]			8 ± 1°C[c]			14 ± 1°C[c]			2o ± 1°C[c]		
	n	$\bar{x}$	± SE	n	$\bar{x}$	± SE	n	$\bar{x}$	± SE	n	$\bar{x}$	± SE[e]
2x D 8/55	54	93,1	o,9	51	6,6	1,5	51	88,o	1,1	57	94,6	o,8
2x D 9/55	64	94,5	o,9	48	2,7	o,9	65	93,3	o,6	57	9o,5	1,6
4x D 8/55	47	67,o	3,1	37	o,5	o,5	51	65,3	2,5	41	48,9	3,4
4x D 9/55	44	62,8	3,6	31	5,2	1,7	5o	67,2	3,2	39	58,o	3,2

[d] at day, at night two degree less [c] constant [e] mean ± standard error

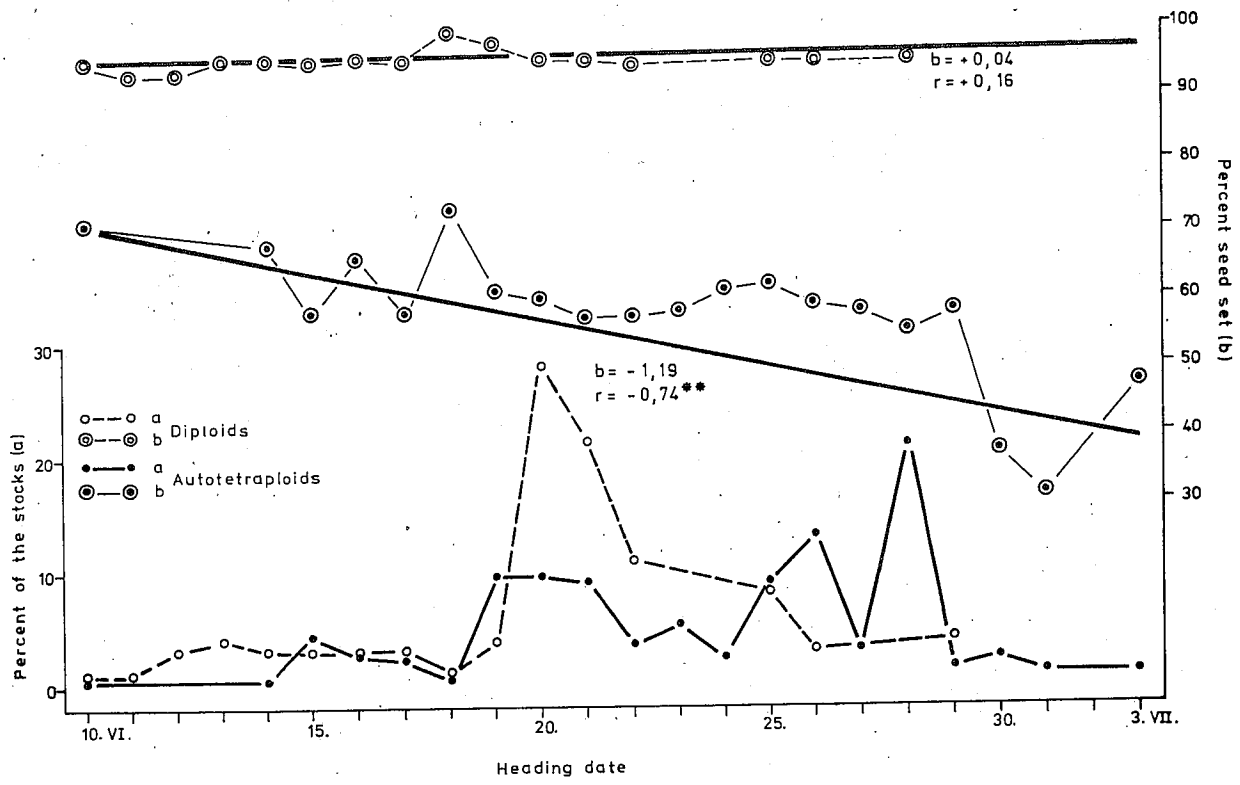

Figure 1 Frequency of the stocks at different heading-dates (lower part) and average seed set of all of the stocks at their specific heading-dates (upper part).

However, even the earliest tetraploid stocks are not completely fertile, so that selection for earliness on its own will not be satisfactorily in this respect. A "diploidisation" of the autotetraploids is required, which mainly consists in its meiotic "bivalentisation". But this seems to be difficult to attain. In a long-term project of "diploidization of autotetraploid barley" we were able to increase the seed setting quite drastically. However, there was no strong tendency to bivalent-pairing of the chromosomes. The regular chromosome distribution, normal gamete formation and increased seed set were rather consequences of predominant "alternative" quadrivalent orientation in the selected tetraploids out of recurrent mutagenic treatment and multiple hybridization as compared to their original autotetraploids (FRIEDT 1978).

References:

Friedt, W. 1978: "Investigations in autotetraploid barley with special reference to its diploidisation". Diss. Techn. Univ. München-Weihenstephan. In press (in German).