

Development and perspectives of MSL- based varieties of spring canola in North America

Olaf Sass, Martin Frauen, Werner Paulmann, Frank Grosse

Norddeutsche Pflanzenzucht Hans-Georg Lembke KG, Hohenlieth, 24363 Holtsee, Germany
Mail: NPZ-Lembke@npz.de

ABSTRACT

For the North American market, two approaches for the use of the MSL-system (Male Sterility Lembke®) in commercial varieties were followed: pure F₁-hybrids and mixed hybrids („synthetic varieties“). For the production of certified seed of mixed hybrids, the pollinator and the sterile line are blended before sowing and harvested as a mixture. Production costs for mixed hybrids are substantially lower compared to pure F₁-hybrids. Exploitation of heterosis in this variety type is only slightly lower as compared to pure F₁-hybrids. The first MSL-hybrid to pass the COOP registration system in Canada was Figaro in 1997 followed by mixed hybrids such as 220 and Golden Boy. In the US, ProGold 701 and CL 2070 were the first F₁-hybrids marketed. Later on improved conventional F₁-hybrids followed such as Canterra 1492 and Hycore 401. Due to the rapid change to GMO canola in North America the market shares of conventional hybrids became restricted irrespective of their high yield performance in trials. Following the quick shift to herbicide tolerance in the market MSL-varieties with Roundup® resistance were developed. This was achieved by combining conventional sterile lines with pollinators carrying the Roundup® resistance gene. Due to the dominance of this gene, the resulting heterozygous hybrids are resistant to Roundup®. MSL-based Roundup® resistant mixed hybrids passed the registration system in Canada of which the most wide-spread today are SW RideR and SP Admirable, in the US e.g. RR 2061 performed very well. New breeding objectives are sterile MSL-lines with Roundup® resistance to improve flexibility of the hybrid variety development. Major efforts are undertaken to increase heterosis in yield and to combine it with high blackleg resistance and the quality parameters required for the North American market.

Key words: Brassica napus – plant breeding – hybrid varieties – mixed hybrid – male sterility

INTRODUCTION

The basic development of the MSL (Male Sterility Lembke®) -hybrid-technology started 1982. First applied approaches were initiated in parallel and resulted in the first registered winter oilseed rape MSL-hybrid in Germany in 1995. Work was always conducted in winter and spring canola with the spring part being in the beginning mostly an accelerated model for the more time consuming work on winter rapeseed. Nevertheless results were encouraging in spring canola as well and increasing efforts were conducted to explore the potential of the MSL-system also in spring canola growing areas worldwide, with the main focus on the North American continent in particular on Canada and the US.

RESULTS AND PROSPECTS

A spring canola breeding program was conducted at NPZ-Lembke® since the beginning of the eighties. This program mainly served as a germplasm source for the development of elite pollinators and elite sterile lines. The material for the North American market was initially preselected for performance and adaptation in Northern European nurseries and then tested in Canada. Later on preselection took place in southern Manitoba.

Especially for North American conditions two types of hybrid varieties were developed. Either hybrid vigour can be exploited in pure hybrids with 100 % F₁-plants which have to be produced in alternating strips. Alternatively hybrid seed can be produced by mixing the pollinator with the sterile line. The commercially grown seed is a mixture, containing F₁-seeds and selfed seed of the pollinator. A proportion of 15 % of the pollinator has proved to be sufficient to achieve full pollination. This variety concept is also commonly known in North America as „synthetic variety“, whereas the correct term would be „mixed hybrid“ as the term „synthetic“ in the comprehensive sense in breeding is defined broader and covers mainly scenarios in which male sterility is not necessarily or explicitly used.

The advantage of the „synthetic“ concept is the easier and less costly way of seed production as there is no need to establish stripes which have to be handled individually. However it must be kept in mind that it requires a thorough selection of the individual hybrid components with respect to vigour, flowering time and maturity, and especially to achieve a good synchronization at flowering time. The disadvantage is that not the full potential heterosis is expressed in this variety type. Experimental results nevertheless have shown that the yield reduction in comparison to pure F₁-hybrids is lower than it would be theoretically expected. The „synthetic“ concept was therefore considered to be a valid and practical alternative and was used to develop varieties for Canada and the US in addition to the pure F₁-hybrid concept.

The first conventional MSL hybrid which was entered into the Canadian COOP system was Figaro in 1995. During the following years a number of high yielding conventional pure hybrids and „synthetics“ were applied and recommended. Pure hybrids with high performance were e.g. Canterra 1492, Hycore 601 and SW 5001. Successful „synthetics“ for example were 220 and Golden Boy. The North American market changed quite rapidly within four years from conventional canola to herbicide tolerant canola and specifically making use of the Roundup[®] herbicide tolerance. This development was also reflected in hybrid varieties based on the MSL system. First varieties released in Canada with the Roundup[®] Ready trait and the MSL technology were the „synthetic“ SW RideR in spring 1999 followed by higher performing „synthetic“ hybrids like SW RazoR, SP Admirable and 799 RR. Pure MSL- F₁-hybrids with Roundup[®]-tolerance released in the recent years were Canterra 1841 and AP 7979-00. In the US the varieties RR 2061 and AP 2066 are the most recent examples for high yielding MSL-based pure F₁-hybrids.

At the moment the share of „synthetic“ hybrids is higher in comparison to pure F₁-hybrids, but the latter class is about to catch up with the „synthetics“. An estimation based on the figures of seed of MSL based varieties sold reveals their current market share in North America to be more than 5%.

Future development will concentrate on identifying superior hybrids which combine quality and resistance characters required for the North American market with high heterosis in seed yield and herbicide tolerance to improve the overall benefit for the farmer.

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