The Impact of Clearfield® Production System on the Quality of Winter Oilseed Rape Oil

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ABSTRACT

Commercial monitoring of European crops indicated that the oil quality of a small but significant proportion of crops is adversely affected by either weeds or High Erucic Acid Rape (HEAR) volunteers.

Clearfield is a new production system for winter oilseed rape, utilizing a combination of herbicide tolerant varieties and imazamox-based herbicides. A two year study showed that Clearfield weed control programs can improve oil quality in a range of winter oilseed rape phenotypes; through broad spectrum activity against problematic weeds like *Sinapsis arvensis*. Particular benefits were seen in High Oleic, Low Linolenic rape where commercial oil quality thresholds already exist. A benefit was also seen in semi-dwarf hybrid rape due to its less competitive growth habit.

MATERIALS AND METHODS

Commercial Crop Monitoring; European commercial crops of High Oleic, Low Linolenic (HOLL) oilseed rape were monitored over a five year period to ensure that they met specific oil specification. The sampled area was 108 thousand hectares across five countries; France, Germany, Sweden, Switzerland and United Kingdom. Crops were grown in the major growing areas for oilseed rape and managed according to normal agronomic practice, with growers advised to minimise the presence of oilseed rape volunteers and weeds on oil quality through careful field selection, rotation and herbicide use. Crops were sampled either on-farm or at holding stores prior to shipment to the crusher and the samples analysed by Monsanto using gas chromatography (GC) (Varian 3900 and Galaxie software) to assess the proportion of palmitic acid (C16:0), staeric acid (C18:0), oleic acid (C18:1), linolenic acid (C18:2), linolenic acid (C18:3) and erucic acid (C22:1) in each sample.

Fatty Acid Profiling of Key Weed Species: A preliminary experiment was carried out to assess the impact of a range of common weed species on the oil quality of oilseed rape. Cleaned weed seeds of common oilseed rape weeds were sourced commercially and included *Brassica kaber*, *Galium aparine*, *Sinapis arvensis*, *Geranium dissectum*, *Papaver rhoeas* and *Capsella bursa pastoris*. Fatty acids were extracted from the seed lots by grinding the seed, extracting the triglycerides using isooctane, and re-esterification using methanolic solution. The fatty acid profiles were determined using GC analysis and compared with a range of winter oilseed rape types including conventional '00' rape, HEAR and HOLL rape.

Field testing of Clearfield Herbicide Programs and Oil Quality: A two year study compared the efficacy of **Clearfield** herbicide with conventional spray programs against high natural infestations of *Sinapsis arvensis* and included other common weeds such as *Gallium aparine, Capsella bursa pastoris, Veronica persica, Geranium dissectum* and wheat volunteers. A range of Clearfield winter oilseed rape phenotypes were assessed including a conventional hybrid, a semi-dwarf hybrid and a HOLL type, with a direct comparison between Clearfield HOLL and a non-herbicide tolerant isogenic line.

The trials were located in a major oilseed rape growing area of the UK and sprayed using a small plot AZO sprayer fitted with flat fan nozzles at 2.5 bar pressure to deliver 200 l/ha water volume. In the first year of testing, a simple comparison was made between the **Clearfield** herbicide, metazachlor:imazamox at 750: 35g ai/ha, and the commercial standard, metazachlor:quinmerac at 1,000:250g ai/ha at two different timings. The early timing at BBCH 1.0 and a later timing at BBCH 1.2-1.4 of the crop. In the second year, the **Clearfield** herbicide was compared at a single timing; BBCH 16-18, with a full commercial spray program; dimethenamid-p:metazachlor:quinmerac at 500:500:250g ai/ha pre-emergence followed by a tank mixture of propaquizafop at 35g ai/ha and bifenox at 480g ai/ha at BBCH 16-18 of the crop. The level of weed control and yield were assessed and harvested crop samples were tested for fatty acid levels.

RESULTS AND DISCUSSION

Results from the commercial monitoring of HOLL crops show that a small but significant number of crops are adversely affected by erucic contamination across Europe (Table 1). On average 2.2% of samples exceeded the FOSFA26a threshold of 2% oil in the seed where rejection of the crop would be possible. Investigation into individual samples revealed that contamination came from two sources, weeds and volunteer HEAR rape. Given that many of early HOLL crops were grown on land not previously cropped with oilseed rape, it is reasonable to anticipate that erucic contamination may be even higher in the general oilseed rape crop.

Table 1. Erucic acid (C22.1) in commercial HOLL oilseed rape crops, 2006-10

Country	Number of years	Total area of crops (ha)	Number of samples	Percentage of samples C22.1 >2%*	Percentage of samples C22.1 >5%
France	6	12668	2052	1.5	0.9
Germany	6	26725	1561	2.8	1.2
Sweden	2	3673	42	0	0
Switzerland	6	23104	743	n/a	n/a
United Kingdom	6	41651	1340	2.5	2.2

*Threshold set by FOSFA26a for oilseeds contracts

Figure 1. Fatty acid profile of oilseed rape types and common weed species

Species	C16.0 - Palmitic	C18.0 - Stearic	C18.1 - Oleic	C18.2 - Linoleic	C18.3 - Linolenic	C20.0 - Arachidic	C20.1 - Eicosenoic	C20.2 - Eicosadienoic	C22.0 - Behenic	C22.1 - Erucic
Oilseed Rape Type										
Conventional 'OO' oilseed rape OSR (c.v. Castille)	4.9	1.5	62.6	20.1	10.9	-	-	-	-	-
HOLL oilseed rape (c.v. Splendor)	4.0	2.0	79.3	12.3	2.6	-	-	-	-	-
HOLL oilseed rape (c.v. V141OL)	3.4	1.8	83.4	8.4	3.0	-	-	-	-	-
High Erucic Oilseed rape (c.v. Hearty)	3.3	1.0	12.5	15.1	8.9	0.8	-	-	1.2	**57.1**
Potential Weed Contaminants										
Raphanus Raphanistrum (Wild Radish)	5.2	1.9	27.3	13.6	11.7	1.2	11.3	0.5	0.6	**26.7**
Brassica Kaber (Wild Mustard)	3.6	1.4	11.6	18.2	19.0	2.0	10.0	1.4	1.3	**31.5**
Galium Aparine (Cleavers)	7.2	1.9	44.3	19.7	17.8	5.1	4.0	-	-	-
Sinapis Arvensis (Charlock Mustard)	3.3	1.1	15.3	16.5	13.0	1.0	15.7	1.2	1.3	**31.7**
Geranium Dissectum (Cranesbill)	14.4	2.0	19.6	45.4	3.4	0.8	2.6	0.4	1.4	**9.9**
Papaver Rhoeas (Common Poppy)	9.5	2.5	10.4	76.7	0.5	0.1	0.1	-	-	-
Capsella Bursa Pastoris (Shepherd's Purse)	7.6	4.5	14.1	22.1	35.2	2.1	12.4	1.7	0.3	-
Erysimum Officinale (Hedge Mustard)	8.7	1.5	6.7	15.4	35.4	1.8	7.0	1.4	1.3	**20.9**

The results of the preliminary weed screen show that several common weeds have oil quality profiles with the potential to adversely affect that of oilseed rape (Figure 1). Their impact on oilseed rape quality will depend on the level of admixture, oil content of the weed and the ability to identify or separate out the weeds with further cleaning. For this reason the brassica species weeds in particular can have a big impact.

Elevated levels of other fatty acids, e.g. C18:3 linolenic, may have a negative impact on the quality of specific oil quality crops (e.g. HOLL rape). This was observed during the commercial monitoring program where contamination by common weeds, HEAR rape and, indeed, conventional '00' rape volunteers, resulted in crops failing to reach specification.

Figure 2. Control of *Sinapsis arvensis* and erucic acid levels in harvested crop, 2009 trial, UK

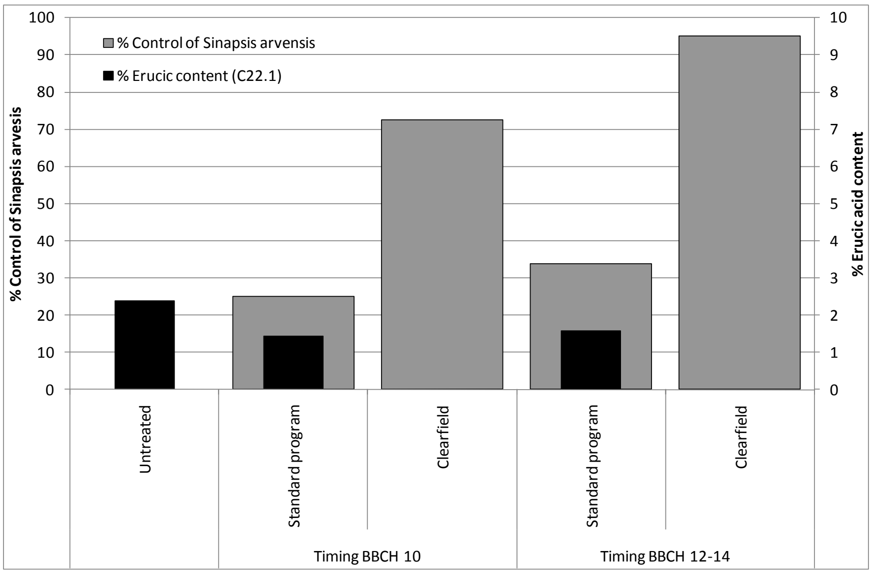


Figure 3. Control of *Sinapsis arvensis* and erucic acid levels in harvested crop, 2010 trial, UK

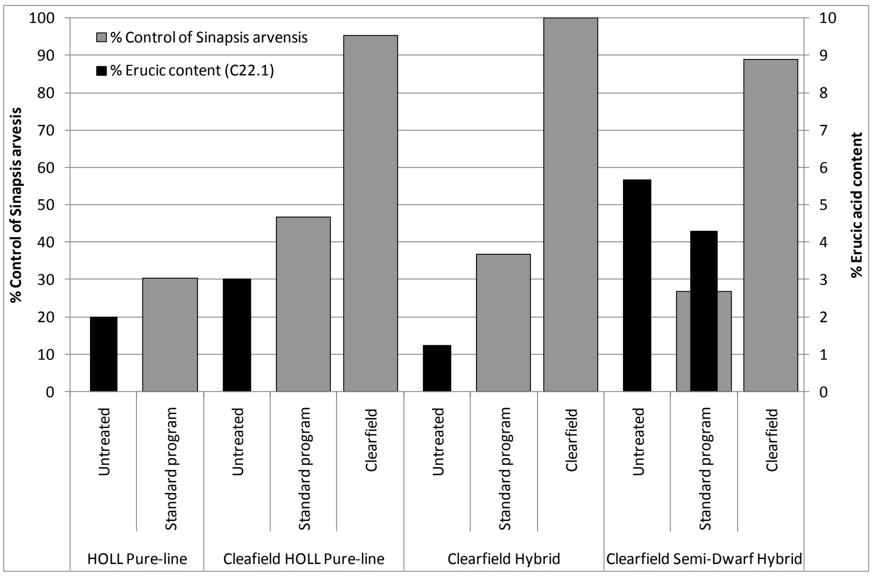
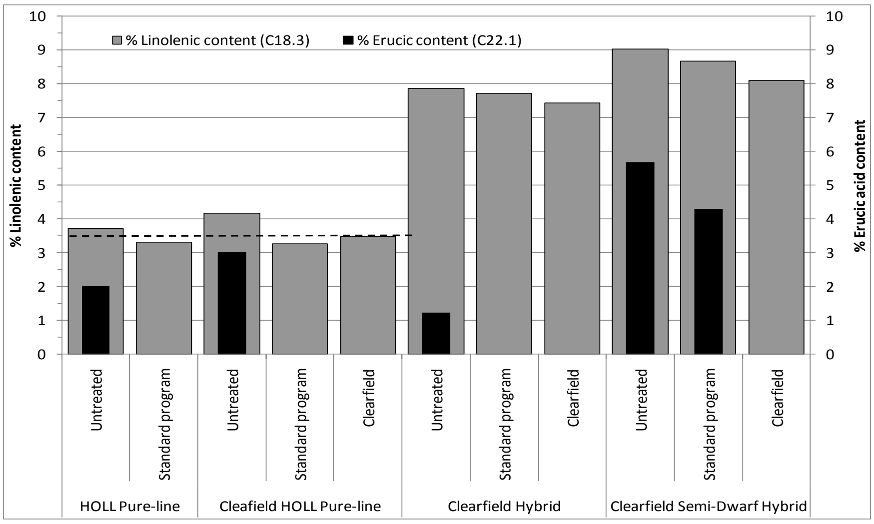


Figure 4. Linolenic and erucic acid levels in HOLL and '00' rape, 2010 trial, UK



The field trials results showed that the **Clearfield** herbicide demonstrated good efficacy against important weed species such as *Sinapsis arvesis* and provided an effective and consistent approach to removing erucic contamination in the harvested crop (Figure 2). The later timing improved the level of weed control as all of the weeds had emerged by this growth stage. In both years the yield benefit generally reflected the level of weed control and there were benefits in grain size and reduced admixture.

There was visual evidence in the trial that the *Sinapsis arvesis* grew above the crop canopy of the semi-dwarf hybrid and, consequently, the weed infestation had a greater impact on oil quality (Figure 3)

Linolenic acid levels can also be elevated through weed contamination. Whilst this is not an issue for conventional '00' oilseed rape, it can can significantly reduce the quality and value of HOLL oilseed rape (Figure 4). These varieties are subject to stringent oil quality thresholds (e.g. C18.3 < 3.5%) which mean that they are particularly sensitive to weed contamination. While the benefit of lower erucic or linolenic acid levels was not seen in all varieties there was a significant benefit from the **Clearfield** system from simplification of the spray program and greater flexibility in the timing of application compared with the commercial program.

In summary, the **Clearfield** production system provides broad spectrum activity against a wide range of weeds in winter oilseed rape. It controls some weeds that are not well controlled by current weed control programmes and some that have a detrimental effect on oil quality which may result in reduced premiums or crop rejection. There was evidence that the technology can improve the quality of oilseed rape oil and this may have a specific value in fatty acid profile types where there is a defined standard. It may also be particularly useful in managing crop phenotypes that are particularly sensitive to weed competition.

REFERENCES

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