Search for chemicals able to control the parasitic plant *Orobanche ramosa* L. and enough selective of a field winter oilseed rape.

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ABSTRACT

Orobanche ramosa is a parasitic plant which is able to use oilseed rape among its host plants. In the West part of France, there is a production area where winter oilseed rape crops are deeply damaged by such a parasitic association. Among the possible solutions to face the problem, we looked for chemicals enough efficient to control the parasite and enough selective towards the crop. 18 different chemicals under different application modalities were tested in randomised block designs with adjacent non treated controls. 3 of them have shown an efficiency even sometimes with visual selectivity problems and losses of plant vigour, and have been tested more deeply during a second and third experimental years. Splited sprays of Glyphosate or maleic hydrazide seem to be the two best compromises between efficiency and selectivity. Nevertheless, selectivity results could be influenced by environmental factors and it would be probably difficult to allow and to develop at the farmers level this kind of risky solutions

Key words : Orobanche-oilseed rape-herbicides-efficiency-selectivity

INTRODUCTION

Orobanche ramosa is a parasitic plant which is able to use oilseed rape among its host plants. It could be found in several areas of production mainly in the south and west regions of France. Since several years an area of around 5000 Ha near La Rochelle (Charentes Maritimes) in the West part of France is deeply damaged. As shown by kilometric surveys, the parasitism seems to increase and would reduce oilseed rape growing areas. Several practices could be used to try to limit the phenomena. Hybrid vigour seems to reduce the impact. Wild hosts species control is probably a good target to reduce future multiplications inside and around the fields. Among the possible solutions to face the problem we have looked for herbicides able to control efficiently the parasite and enough selective to the oilseed rape canopy.

MATERIALS AND METHODS

Candidate chemicals were selected from the pesticides ACTA index book published each year and giving all the chemicals allowed for different crops. 14 chemicals in 19 modalities were tested during the first experimental year in field experiments in 1999-2000. During the second experimental year (2000-01), 8 different chemicals were tested for a total of 22 modalities. Four chemicals were already tested the previous year, four others were newly tested. During the third experimental year in 2001-2002, the experiment was focussed on two chemicals which gave the best results. Randomised block design were used with adjacent non treated controls following the CEB methods. Two replicates were done in 1999-2000 and in 2000-2001, and three replicates in 2001-2002. Zenith, a registered sensitive genotype was used during the two first years of experimentations. During the third year we used Extra an Ogu-INRA restored hybrid which seems to be less sensitive. Field experiments were carried out in fields strongly contaminated with *Orobanche ramose.* Average populations of flowering *Orobanche* were 280, 200, 130 Orobanches per square meter respectively, which were high levels of colonisation. Following the different modalities, chemicals were applied before, or after sowing . Post emergence applications were carried out from mid September to beginning of February. Visual selectivity was registered several times along the growing cycle from October to May using CEB official scales. Results from March will be presented here. Efficiency was registered twice after the parasite emergence, comparing Orobanche densities on each plot with densities on the adjacent non treated control.

. RESULTS

The following chemicals, at different concentrations and dates of application were inefficient to control *Orobanche ramosa*: Imazamethabenz, Pichlorame, Chlothal, carbetamide, Dalapon, Ethephon, Ethephon + mepiquat chlorure, trinexapacethyl, pacloburazol + chlormequatchlorure.

Imazaquine has shown a low efficiency the first year and inefficiency the second year for several application modalities.

Table 1 : effiency and selectivity for different modalities of Propyzamide applications during two cropping seasons

Propyzamide	quantity	application date	efficiency %	selectivity
	g /Ha		Late May	March
1999-2000	750g	Seed treatment + Pre-emergence	90	999
2000-2001	750g	Pre sowing 28-08	0	111
	750g	Pre emergence 29-08	0	111
	750g	Post emergence 18-09	0	111
	750g	Post emergence 28-11	43	111
	750g	Post emergence 01-02	10	111

Three herbicides have shown efficiencies during several years, often with selectivity difficulties going from losses of plant to partial and temporary toxicity observed on leaves coloration.

Propyzamide has shown a good efficiency to control orobanche when seeds were treated added with a pre emergence application. Nevertheless the chemical was toxic for the oilseed rape plants with a reduction of half the population and a significative delay in plant emergence. Post emergence applications were generally of poor efficiency except when applied at the beginning of winter. No problem of selectivity was registered for post emergence applications.

Table 2 : effiency and selectivity for different modalities of maleic hydrazine applications during three cropping seasons

maleic hydrazine	quantity	application date	efficiency %	selectivity
	g /Ha		late May	March
1999-2000	700g	Post emergence 01-12	82	111
	1400g	Post emergence 01-12	94	433
2000-2001	700g	Post emergence 18-09	15	111
	700g	Post emergence 28-11	65	111
	700g	Post emergence 01-02	30	111
	1400g	Post emergence 01-02	63	111
	2 x 700g	Post emergence 28-11 + 01-02	80	111
2001-2002	480g	Post emergence 19-11	33	114
	480g	Post emergence 29-01	27	111
	640g	Post emergence 19-11	15	115
	640g	Post emergence 29-01	35	111
	2 x 640g	Post emergence 19-11+ 29-01	95	115

Maleic hydrazine looks much more efficient even with irregular results. The best efficiencies were reached with double applications or high concentrations. Leaves decolorations were noticed for autumn applications the third year. Nevertheless selectivity observations were generally good at spring, except during the first year where leaves decoloration and strong decrease of vigour at spring were observed for the highest rate of application.

Glyphosate was also tested during three experimental years. High levels of efficiency were always observed. During the first year, vigour decreases were noticed especially for the highest concentration, but selectivity remained good. During the following seasons, decreases of vigour and slight decolorations were seen after autumn applications. Winter applications just before growth starts again were much more toxic with decolorations, vigour decreases and stem deformations.

Table 3 : effiency and selectivity for different modalities of glyphosate applications during three cropping seasons

Glyphosate	quantity	application date	efficiency %	selectivity
	g /Ha		late May	March
1999-2000	2 x 108g	Post emergence 01-12 + 20-01	51	111
	2 x 162g	Post emergence 01-12 + 20-01	98	111
	216g	Post emergence 20-01	94	111
2000-2001	216g	Post emergence 28-11	94	333
	162g	Post emergence 01-02	63	454
	2 x 108g	Post emergence 28-11 + 01-02	78	454
2001-2002	108g	Post emergence 19-11	82	111
	108g	Post emergence 29-01	90	336
	144g	Post emergence 19-11	87	311
	144g	Post emergence 29-01	83	556
	2 x 108g	Post emergence 19-11+ 29-01	90	311

DISCUSSION

Parasitic non photosynthetic plants like *Orobanche ramosa* are able to reduce strongly grain yield productivity even with a low number of parasitic plant per host plant. A chemical protection has to face several difficulties. We are looking for an herbicide able to destroy the parasite without damaging the host. This means that we need an equilibrium between efficiency and selectivity. Our results are showing that there is no easy solution. On one side we got low efficient but selective herbicides. These chemicals are probably not enough when the parasitism is high. They could have perhaps an interest with low Orobanche populations. On the other side we demonstrated that glyphosate is the only herbicide to reach a high level of efficiency, despite selectivity problems. Glyphosate is a total contact herbicide generally used at a rate of 2 litres per Hectare. The idea is to found the rate for which the parasite is already sensitive, and the plant still resistant. This equilibrium could move and depend of application rates, Host stages, climatic conditions, and so on. Our results are not suffisant to determine this rate. The risk is on each side : Inefficiency in the parasite control or a destruction of the crop by the herbicide. This risk is probably to high for a market release authorization. Practically, the herbicide has to be applied before the emergence of the parasite. This makes the decision to apply the herbicide difficult for the farmer. Rates of colonisation can be checked only by destructive observations on the root system. On classical oilseed rape, glyphosate application looks like an extrem potential solution for deeply contaminated conditions. Nevertheless we could expect easier results with GMO oilseed rape genotypes resistant to glyphosate or an other non specific herbicide.

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