SUNFLOWER CROPS AND SLUGS

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SUMMARY

From 1986 to 1989, we observed the development of sunflower crops in the South-West of France (area of Toulouse) to determine the importance of difficulties related to slugs.

Among 35 sunflower crops, in chosen fields, we characterized 7 occurrencies of slug attacks connected with severe damage, due most often to an extreme susceptibility of young plants rather than to special aggressiveness of pests.

But, this 4 year survey revealed that, with or without slugs, an optimum development of sunflower crop may encounter some other adverse factors, such as : birds (constant problem, difficult to appreciate without more investments), wireworms (revaled incidences among crops ; all soils treated with microgranulated insecticides), seed quality, tillage practices and seed bed preparations and, sometimes, rabbits (1988).

INTRODUCTION.

From 1986 to 1989, we observed the development of sunflower crops in the South-West of France (area of Toulouse) to study the dynamics of slug populations (BALLANGER, CHAMPOLIVIER - 1990) and determine the importance of difficulties related to slugs.

One of the aspects of this study consisted in annual surveys of some fields aiming at evaluating slug damage among all other causes of loss for productive plants.

Sunflower crops compensate rather badly for irregularities in a plant settlement. It is therefore of main interest that the rate of emergence be as high as possible (PICQ - 1985, 1991).

MATERIAL AND METHODS.

The study was carried out in an area of 15 kilometers around Baziège (Haute-Garonne). Observations were conducted in 6 fields (601 to 606) in 1986, 8 fields (701 to 708) in 1987, 12 fields (801 to 812) in 1988, and 9 fields (901 to 909) in 1989. Each year, fields were chosen for slug risks expected rather higher than elsewhere.

In each field, four small plots - the four corners of a virtual square of 25-30 meter sides - with 4 lines of 4 meters were marked out before the first plants appeared. After that, at the rate of one or two visits a week, all visible plants were recorded and followed. Later on (5-6 leaves), the empty sowing sites were searched to try to determine the causes of plant lacks, and we examined the roots of small and/or unhealthy plants.

TABLE 1 - CHARACTERIZATION OF SUNFLOWER CROPS BY REPEATED VISITS IN THE FIELDS (Symbols used in Tables 2 to 5)

SEEDLINGS : theoretic drilling calculated from S1 (seeds by hectar, row-spacing : 45 or 60 cm)
S1 : total sowing sites (evaluated from regular seed spacing)
MS : multiple sowing sites (more than 1 plant for 1 sowing site)
MS % = MS / S1 * 100
D1 : unoccupied sowing site (no viable plant)
D1 = E + B + P + O
E : empty sowing sites (bad recovering by direct soil searching, lacks of seed deposit, full seed appropriation by birds)
B : hypocotyls cut off by birds ("typical" damage.
P : sunflower seeds or plants, definitively damaged by pests, slugs or wireworms (COLEOPTERA, ELATERIDAE)
O : others causes of plant lacks without pest damage, related to seed quality, tillage problems, diseases, ...
S2 : viable sowing sites (at least, one viable plant per site)
S2 % = 100 - (D1 / S1 * 100)
D2 : unproductive occupied sowing sites (no productive plant)
D2 = U + R
U : small, unhealthy plants
R : stems cut off by rabbits
S3 : productive sowing sites (At least, one productive plant per site)
S3 % = 100 - ((D1 + D2) / S1 * 100)
-- For 4 plots of 4 4-meter lines --

RESULTS.

The modalities of sunflower crop developments were detailed for 35 fields over a period of 4 years with different agroclimatic conditions. *Deroceras reticulatum* (grey field slug - GFS), *Arion hortensis* (black field slug - BFS) and *Arion subfuscus* were the slug species met most often.

1 - SURVEY 1986.

At the end of the cold period, first observations in ploughed lands allowed us to characterize two high levels of slug infestations (601, 602). But, in both cases, the slug populations decreased progressively, and, at sowing time, the last surviving adults were not numerous. Following a rapidly hot and dry spring-period, no new generation appeared.

TABLE 2 - 1986 Sunflower Crops (601 to 606) - (See Table 1).

	Seedlings			%	D1					%	D2			%
		S1	MS	MS		E	B	P	O	S2		U	R	S3
601	72200	208	10	5	26	4	0	14	8	88	10	10	0	83
602	82300	237	9	4	83	16	0	62	6	65	8	8	0	62
603	70800	204	8	4	6	1	1	1	3	97	2	2	0	96
604	77800	224												
605	63900	184	1	1	11	3	0	2	6	94	8	8	0	90
606	71900	276	7	3	21	5	1	5	10	92	11	11	0	88

In the first year of our survey and in 5 fields, we observed that plants had developed in 88 to 97 % of sowing sites. Other causes of plant lacks were attributed mainly to no germinating seeds. Pest damage occurred in two situations : field 601, slugs and wireworms ; field 602, birds (included in empty sowing sites), slugs and wireworms. In the last case, high losses of young plants could be explained by a fugacious activity of slugs, stimulated by local rainfalls (stormy weather). Only attacked on the soil level, but not really consumed, the attacked plants were unable to outlive damage (38 plants, out of 52 for slugs, were so killed).

In the sixth field, where sunflower seeds had been sown irregularly, a precise characterization of the situation was not really possible. High bird damage was recorded in one to three of the four plots in which we obtained : 27, 41, 44 or 53 plants.

2 - SURVEY 1987.

After a long period of drought, from March 1986 to February 1987, it became very unusual to meet slugs in ploughed lands.

Even though, in this context, the rates of occupied sowing sites were rather far from 100 % : varying between 78 and 87 %. Even if "empty sowing sites" mean an empty class (704), generally, it is a well-supplied class (40 % of unoccupied sowing sites - 7 fields) which, with typical bird damages, represented 49 % of missing plants.

Moreover, irreversible damage due to pests and other causes were important (50 % - 8 fields).

TABLE 3 - 1987 Sunflower Crops (701 to 708) - (See Table 1).

	Seedlings			%	D1					%	D2			%
	S1	MS	MS		E	B	P	O	S2		U	R	S3	
701	85100	245	9	4	36	15	7	14	0	85	18	18	0	78
702	76400	220	9	4	40	19	2	18	1	82	7	7	0	79
703	76400	220	4	2	39	15	2	10	12	82	8	8	0	79
704	70800	204	7	3	26	2	1	17	6	87	11	11	0	82
705	82600	238	4	2	58	21	8	19	10	76	5	5	0	74
706	72600	209	5	2	32	16	4	3	9	85	7	7	0	81
707	76700	221	4	2	28	11	0	8	9	87	0	0	0	87
708	85400	328	48	15	63	20	3	31	9	81	16	16	0	76

- Pests attack germinating seeds and young plants in the soil, before emergence (119 cases out of 120). For the major part, such damage must be attributed to wireworms. In 6 fields out of 8, this kind of losses concerned 7.5 % of the sowing sites.

- Other unoccupied sowing sites were not important (701, 702) or related to an absence of germination (4 % of the sowing sites - 703, 704, 705 and 707) or to emergence difficulties for plants blocked under balls of earth (3 % - 706, 708).

When the vegetative phasis is well-induced, we can see that plant settlements are rather homogeneous (5 fields). But, in 3 situations, we can observe quantities to be taken on account of small and unhealthy plants consisting in 5 to 7 % of the sowing sites.

3 - SURVEY 1988.

After summertime, drought went on until the autumn of 1987, until a reversal of the climatic context. January, March, April and May 1988 were characterized by abundant rainfalls (subsoiling, floods). We observed that slugs reappeared.

TABLE 4 - 1988 Sunflower Crops (801 to 812) - (See Table 1).

	Seedlings			%	D1					%	D2			%
	S1	MS	MS		E	B	P	O	S2		U	R	S3	
801	76400	220	19	9	60	3	1	55	1	73	7	7	0	70
802														
803	73600	212	6	3	18	3	2	0	13	92	00	1	0	92
804	72200	208	1	1	24	3	0	15	6	88	40	10	30	69
805	62500	180	0	0	18	7	0	1	10	90	5	5	0	87
806	72200	208	6	3	20	7	1	4	8	90	5	3	2	88
807	67700	195	7	4	80	10	0	66	4	59	28	28	0	45
808	66700	192	1	1	36	8	1	26	1	81	14	14	0	74
809	64200	185	1	1	25	9	0	11	5	86	3	2	1	84
810	64600	248	29	12	20	3	1	5	11	92	39	15	24	76
811	64600	248	7	3	189	24	-	-	-	24	10	10	0	20
812	62500	240	8	3	41	3	0	15	23	83	12	11	1	78

Unexplained empty sowing sites and typical bird damage were often unsignificant (the field 802 was affected by seed dormancy and no plant appeared). In some cases, other causes of plant lacks represented a major handicap in the studied field (803, 805, 806 and 810 : 42 cases) with - essentially - difficulties for the plants to extract themselves from the soil (21 cases), or no developing seeds (12 cases). Thus, for the field 812, a too deep seed-bed, among 23 other causes of empty sowing sites, we recorded 17 plants, exhausted before reaching the soil surface. The field 812 was also concerned by pest damage and losses of 15 sowing sites (6 %) induced by GFS. In the field 809, where moderate pest damage was attributed to young BFS and wireworms, 5 situations were subjected to slug attacks.

- Fields 807 and 808 - Some adults of GFS were soon active at sowing time and some plants were cut off. Renewed rainfalls induced two modalities of evolution in slug populations. In the field 807, a plethoric hatching was followed by high damage on young plants. For 195 sowing sites, we checked the emergence of 175 plants before the disappearance of 70 plants left a plant settlement of only 115 present plants and 87 productive plants. In the field 808, as the soil was - just - overflowed, no new generation appeared.

- Fields 801 and 804 . - In the field 804, BFS and wireworms shared the destruction of 15 plants (7 %). In the field 801, a new generation of BFS caused the disappearance of 55 plants (25 %) by a late activity on a late crop.

- The field 811 represented a complicated system, in which a bad soil structure was associated to high levels of slug populations, usual species and numerous other species (Arion sp. and Milax sp.). A first sowing (248 sowing sites) was followed by the emergence of 126 plants among which 67 were destroyed (before a second sowing).

Later, in some situations, unusual high damage due to rabbits and/or high levels of small plants were also recorded.

4 - SURVEY 1989.

In 1988, after abundant rainfalls in the first part of the year, a new period of drought developed until February 1989. Then, the situation became more propitious to slug activity, with a wet and cool weather, in a context of gradual growth for sunflower plants.

TABLE 5 - 1989 Sunflower Crops (901 to 909) - (* for 2 plots) - (See Table 1).

	Seedlings			%	D1					%	D2			%
	S1	MS	MS		E	B	P	O	S2		U		R	S3
901	72200	208	11	5	153	19	12	120	2	26	00	00	0	26
902	76700	221	19	9	48	35	5	1	7	78	8	8	0	75
903	70800	204	9	4	51	29	11	8	3	75	9	9	0	71
904	71900	207	5	2	38	18	0	12	8	82	8	8	0	78
905*	73400	141	16	11	29	12	2	8	7	79	11	11	0	72
906	62000	238	12	5	57	9	3	5	40	76	18	18	0	68
907	58100	223	12	5	30	3	2	1	24	87	13	13	0	81
908	62500	240	4	2	45	31	1	12	1	81	4	4	0	80
909	54400	209	18	9	33	15	7	9	2	84	3	3	0	83

The numbers of sowing sites occupied by a viable plant did not exceed 87%, and by a productive plant, 83%.

Sunflower crops are willingly haunted by birds, and unexplained empty sowing sites and typical bird damage represented large classes of unoccupied sowing sites (901 : 20%, 903 : 19%). Other pests did not cause much damage (8 fields, rather wireworms than slugs) except in the field 901 (sunflower following alfalfa). Other causes of empty sowing sites concerned 17% for the field 906 and 11% for the field 907. There, rates of small plants were also higher than elsewhere and growers put that on account of seed quality.

DISCUSSION AND CONCLUSION.

In a region where the soil dehydratation is usually high in summer, it is possible to encounter difficulties related to slugs, even in a climatic context particularly dry as happened from 1986 to 1990. For slug populations, an adverse general situation seems to be easily reversible (1988) or locally overcome, and modalities of attacks are as varied as possible. So, among 35 sunflower crops, in chosen fields, we characterized 7 occurrencies of slug attacks connected with severe damage due, most often, to an extreme susceptiblity of the young plants rather than to a special aggressiveness of pests.

However, this 4 year survey revealed that, with or without slugs, an optimum sunflower crop development may encounter some eventual trouble, such as : birds (general problem, difficult to appreciate without more investments), wireworms (revaled incidences among crops ; all soils treated with microgranulated insecticides), seed quality, tillage practices and seed bed preparations and, sometimes, rabbits (1988).

So, for our 35 fields, percentages of productive sowing sites did not reach 90 % in 32 cases, 80 % in 21 cases.

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