

Weed mapping in Sweden

– report from an on-going development project for weed surveys and report system

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The project

- Financed by the Swedish Board of Agriculture
- Two parts:
 - Develop a method for regular surveys of the weed flora and frequency
 - Develop a system for voluntary reports on findings of invasive agricultural weeds

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Project, part 1

Aims

- Develop a method for repeated registrations of
 1. changes in weed flora
 2. changes in weed infestation
 3. interactions with changes in climate and cultivation system

1 and 2 should answer the main questions:

- Does the occurrence of a specific species change over time
 - in a specific region?
 - in a specific crop?

3 should offer the possibility to answer the question

- Why have these changes occurred?

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Project method

- Literature survey and discussions
- Statistical evaluation of previous field experiments
 - Data from 3yrs field experiment
 - Data on variation within a season
 - Data from thousands of Swedish herbicide field experiments
- Test survey
 - Data on variation among fields
 - Test of method (estimation of time etc.)

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Important choices for the method

1. Selection of field and farm
2. Repeated registration in the same field or not; at the same farm or not?
3. Quantification of weed occurrence
4. Herbicide treated plots or non-treated?
5. Yearly registrations or campaigns?
6. How many crops, and which crops?
7. How many regions, and which?
8. Sample plots: number, size and placement in the field?
9. Which additional data?



Yearly surveys or campaigns?

- To some extent important from a statistical viewpoint – easier to detect a trend with several points
- A disadvantage with long intervals between fresh data
- ...but mostly a question of what is practical and efficient



How many crops and which?

- Winter cereal – the most important crop
- Spring cereal → adds summer annual species
- Oil seed crop → partly other weed species in herbicide treated sample plots
- Majs – “new” crop for Sweden. Longer growing season, poor competition → partly other weed species



Treated or non-treated plots?

- Untreated sample plots: show most of the species with a potential to occur in the field
- Herbicide treated sample plots: registration of species, which actually are capable of growing under the given conditions (treatment effect)
- Which situation is most relevant?



Quantifying weed occurrence

Alternatives:

1. Only registration of occurrence/non-occurrence in sample plots (e.g. 10 x 0.25 m²)
2. Counting number of individuals or shoots
3. Estimating the degree of cover
4. Harvesting and weighing biomass
5. Photos for later image analysis



Statistical strength

Provided you have a certain variation in data, ***how many fields are needed*** to detect a certain change in weed frequency with a desired statistical certainty?



Analysis: how many fields are needed?

- The tables show the number of fields needed to be investigated to detect an increase in frequency of a species, p_0 to p_1 between two years.
- Two types of error should be taken into account; the first denotes the risk of by mistake assume an increase, and the other is the risk of missing an increase. Both risks have been set to 0.05.
- The unit σ^2 denotes the variation among fields, which affects the likelihood of a specific species in the 10 plots investigated in each field

σ^2	p_1	0.15	0.20	0.30	0.40	0.50	0.75	0.90
p_0	0.10	0.15	0.20	0.30	0.40	0.50	0.75	0.90
0.05	242	72	36	16	9	6	2	1
0.10	-	447	122	35	17	10	4	2
0.25	-	-	-	948	110	41	10	5

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Analysis, cont.

σ^2	p_1	0.15	0.20	0.30	0.40	0.50	0.75	0.90
p_0	0.10	0.15	0.20	0.30	0.40	0.50	0.75	0.90
0.05	206	61	31	13	8	5	2	1
0.10	-	385	106	30	15	9	3	2
0.25	-	-	-	833	97	36	9	5

σ^2	p_1	0.15	0.20	0.30	0.40	0.50	0.75	0.90
p_0	0.10	0.15	0.20	0.30	0.40	0.50	0.75	0.90
0.05	149	45	23	10	6	4	2	1
0.10	-	285	79	23	11	7	2	1
0.25	-	-	-	635	74	27	7	4

σ^2	p_1	0.15	0.20	0.30	0.40	0.50	0.75	0.90
p_0	0.10	0.15	0.20	0.30	0.40	0.50	0.75	0.90
0.05	50	15	8	3	2	1	1	1
0.10	-	86	24	7	3	2	1	1
0.25	-	-	-	168	20	8	2	1

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The "fork" alternative



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Preliminary recommendation

- Yearly surveys
- Three regions
- Two crops – winter cereals and spring cereals
- Farms included in the national crop protection warning system
- Un-treated sample plots
- Registration only of occurrence/non-occurrence in 10 sample plots per field
- Additional information on
 - Coordinates, crop, conventional/organic (minimum)

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Project part 2 – aims

- Develop a system for reporting findings of newcomers in agricultural fields:
 - Species established as agricultural weeds, but only in parts of the country
 - Species established in the flora, but as yet not in agricultural fields
 - Species known as weeds in other countries but not established in the Swedish flora

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Reports

- Agricultural complement to the existing "Artportal"
<http://www.artportalen.se/plants/default.as>
[p](#)
- the Weed Advisor ("Ogräsrådgivaren")
<http://ograsradgivaren.slu.se/index.htm>

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Variation among fields: some examples

Art	Untreated		Treated	
	Occurrence	Sigma2	Occurrence	Sigma2
<i>Viola arvensis</i>	60 %	2,07	39 %	2,30
<i>C. album</i>	53 %	2,42	35 %	2,38
<i>Galium aparine</i>	44 %	2,84	45 %	1,57
<i>Galeopsis spp.</i>	38 %	4,94	32 %	3,17
<i>T. perforatum</i>	28 %	1,13	10 %	0,73
<i>P. aviculare</i>	23 %	1,40	13 %	1,13
<i>C. cyanus</i>	20 %	4,73	7 %	1,33
<i>Lamium spp.</i>	18 %	2,27	46 %	2,29
<i>Sonchus asper</i>	16 %	1,92	6 %	0,88
<i>E. helioscopia</i>	15 %	3,00	12 %	1,80
<i>Fumaria officinalis</i>	7 %	0,34	22 %	1,38
<i>Sinapis arvensis</i>	6 %	1,30	5 %	0,59

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