PRODIVA project:
Crop diversification and weeds

Work package 2:

Crop mixtures for weed suppression

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Annual meeting of project PRODIVA, CoreOrganic
18th and 19th, March 2015 , Rostock, Germany

Field experiment

Field experiment: four replication, plots size 11 m x 1,5 m; sowing date: 20.04.2015

Treatments in field (with couch grass):

- **A: Organic: cultivation complies with the principles organic farming from 8 years**
  - **1.** pure barley 350 seeds/m^2
  - **2.** pure pea 110 seeds/m^2
  - **3.** mixture of barley and pea 175 + 55 seeds/m^2
  - **4.** only natural weeds
  - **5.** pure barley 300 seeds/m^2
  - **6.** pure barley 250 seeds/m^2
- **B: Conventional (IPM) cultivation - using herbicides, nitrogen fertilization,**
  - **11.** pure barley 350 seeds/m^2
  - **12.** pure pea 110 seeds/m^2
  - **13.** mixture of barley and pea 175 + 55 seeds/m^2
  - **15.** pure barley 300 seeds/m^2
  - **16.** pure barley 250 seeds/m^2

Analysis performed regarding to:

- dry weight of crops and weeds (above the ground)
- LAI, gNDVI (***G**reen **N**ormalised **V**egetation **I**ndex*)
- number of ears/grain and pods/seeds (No/m^2)
- quantity and quality of yield

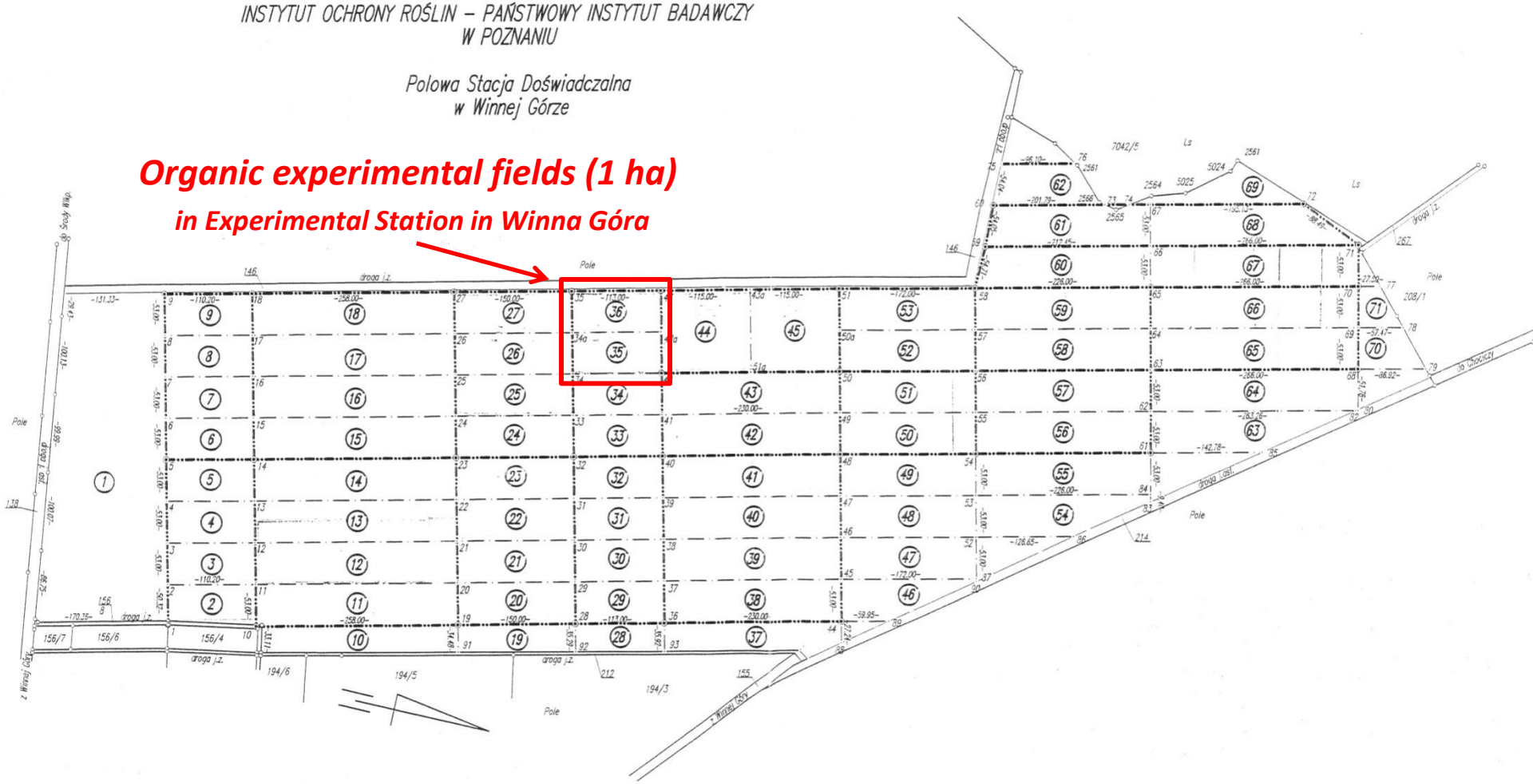
MAPA SYTUACYJNO–POGLĄDOWA POLA DOŚWIADCZALNEGO
skala 1:5000

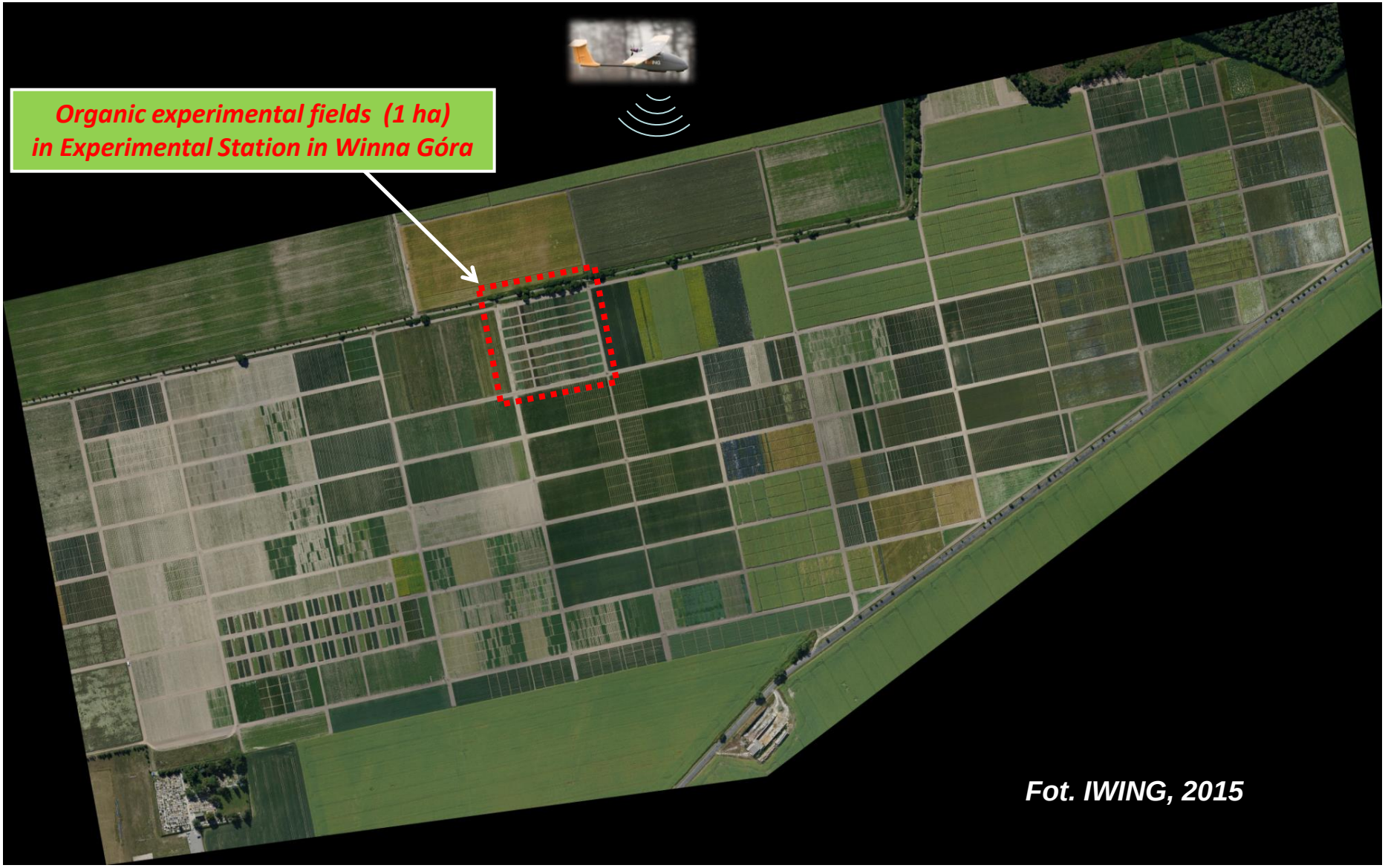
INSTYTUT OCHRONY ROŚLIN – PAŃSTWOWY INSTYTUT BADAWCZY
W POZNANIU

Polowa Stacja Doświadczalna
w Winnej Górze

Organic experimental fields (1 ha)

in Experimental Station in Winna Góra



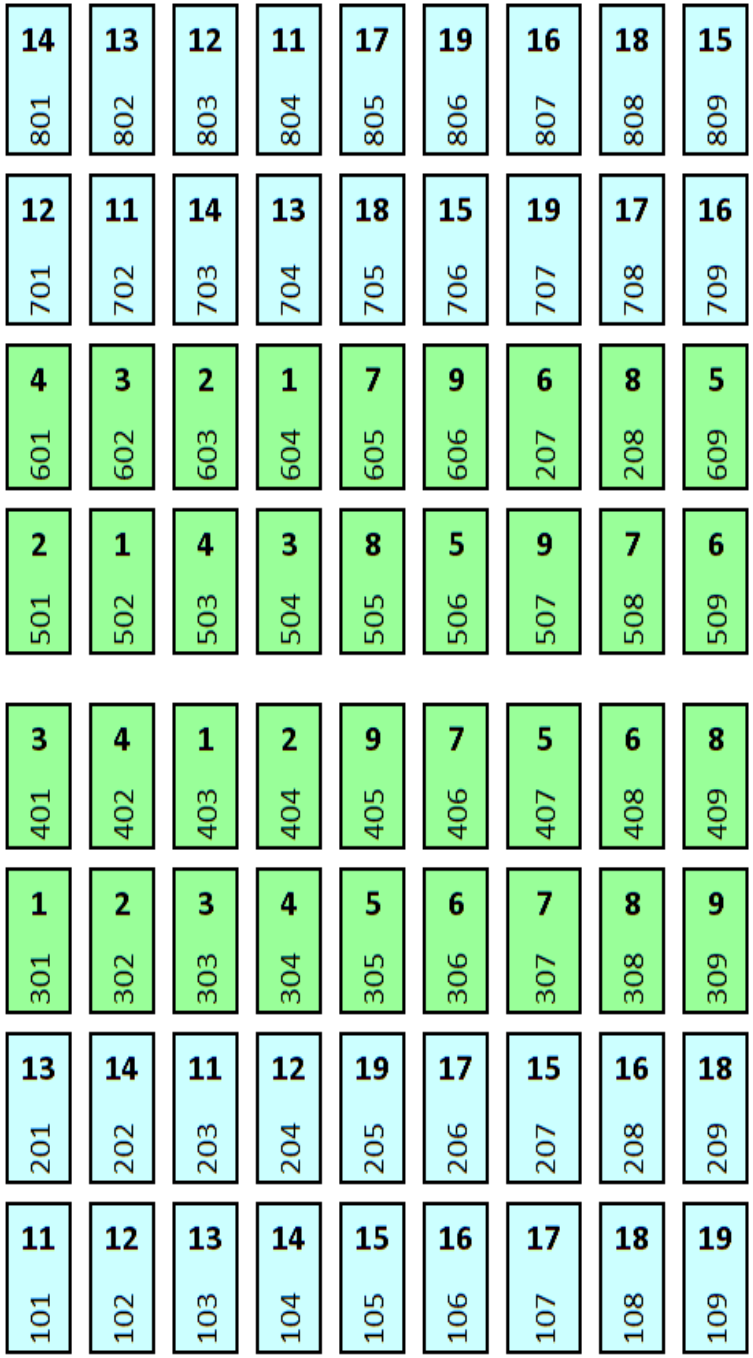

Organic experimental fields (1 ha)
in Experimental Station in Winna Góra
Fot. IWING, 2015

Experimental area

101	201	301	401	501	601	701	801
102	202	302	402	502	602	702	802
103	203	303	403	503	603	703	803
104	204	304	404	504	604	704	804
106	206	306	406	506	606	706	806
107	207	307	407	507	607	707	807
108	208	308	408	508	608	708	808
109	209	309	409	509	609	709	809
110	210	310	410	510	610	710	810
111	211	311	411	511	611	711	811
112	212	312	412	512	612	712	812

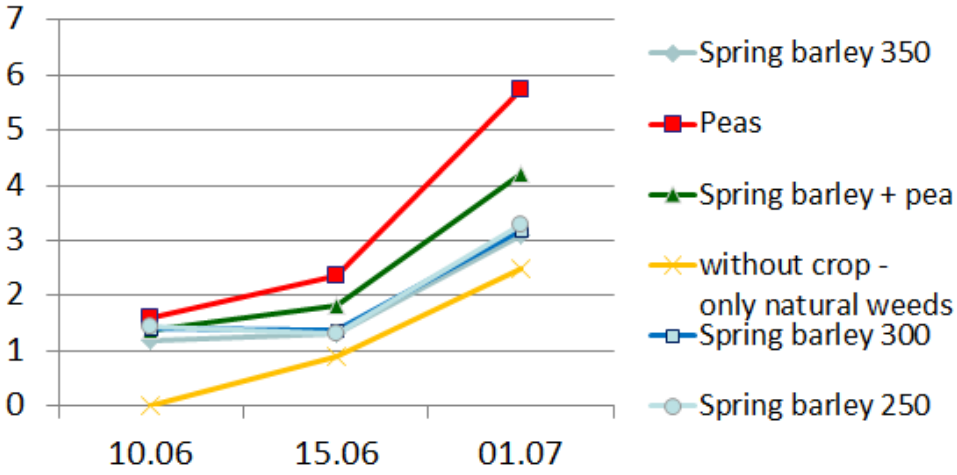
1801	2801	3801	4801	5801	6801	7801	8801
1802	2802	3802	4802	5802	6802	7802	8802
1803	2803	3803	4803	5803	6803	7803	8803
1804	2804	3804	4804	5804	6804	7804	8804
1805	2805	3805	4805	5805	6805	7805	8805
1806	2806	3806	4806	5806	6806	7806	8806
101 11	201 13	301 1	401 3	501 2	801 4	701 12	801 14
102 12	202 14	302 2	402 4	502 1	802 3	702 11	802 13
103 13	203 11	303 3	403 1	503 4	803 2	703 14	803 12
104 14	204 12	304 4	404 2	504 3	804 1	704 13	804 11
105 15	205 19	305 5	405 6	505 8	805 7	705 18	805 17
106 16	206 17	306 6	406 7	506 5	806 6	706 15	806 19
107 17	207 15	307 7	407 5	507 6	207 6	707 16	807 16
108 18	208 16	308 8	408 9	508 7	208 8	708 17	808 18
109 19	209 18	309 9	409 8	509 9	809 5	709 19	809 15

1813	2813	3813	4813	5813	6813	7813	8813
1814	2814	3814	4814	5814	6814	7814	8814
1815	2815	3815	4815	5815	6815	7815	8815
1816	2816	3816	4816	5816	6816	7816	8816
1817	2817	3817	4817	5817	6817	7817	8817
1818	2818	3818	4818	5818	6818	7818	8818
1819	2819	3819	4819	5819	6819	7819	8819
1820	2820	3820	4820	5820	6820	7820	8820
1821	2821	3821	4821	5821	6821	7821	8821
1822	2822	3822	4822	5822	6822	7822	8822
1823	2823	3823	4823	5823	6823	7823	8823
1824	2824	3824	4824	5824	6824	7824	8824
1825	2825	3825	4825	5825	6825	7825	8825
1826	2826	3826	4826	5826	6826	7826	8826
1827	2827	3827	4827	5827	6827	7827	8827
1828	2828	3828	4828	5828	6828	7828	8828

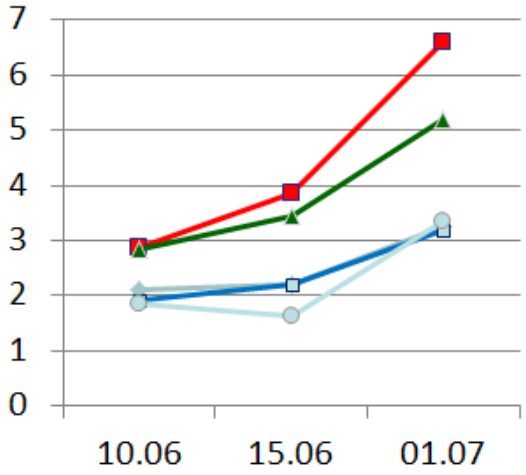


No tretment		Crop species	Seed rate No./m^2
1	Crop production systems- **Organic**	**Spring barley**	**350**
2		**Pea**	**110**
3		**Spring barley + pea**	**175 + 55**
4		**Without crop** - only natural weeds	**-**
5		**Spring barley**	**300**
6		**Spring barley**	**250**
11	Crop production systems- **Conventional (IPM)**	**Spring barley**	**350**
12		**Pea**	**110**
13		**Spring barley + pea**	**175 + 55**
15		**Spring barley**	**300**
16		**Spring barley**	**250**

Index LAI

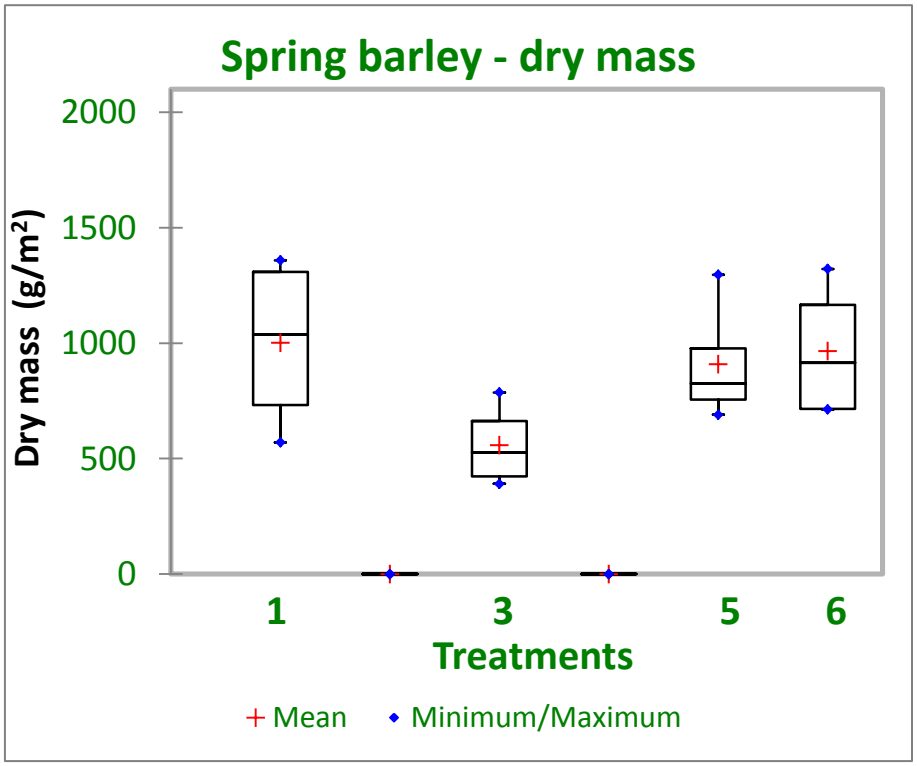


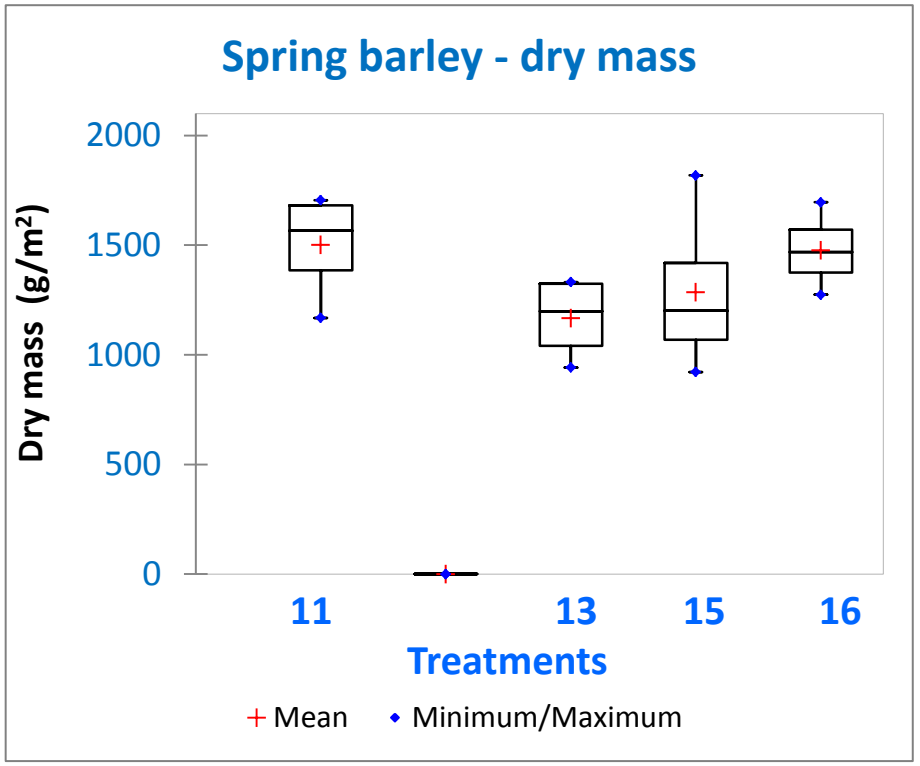
Organic system



IPM system

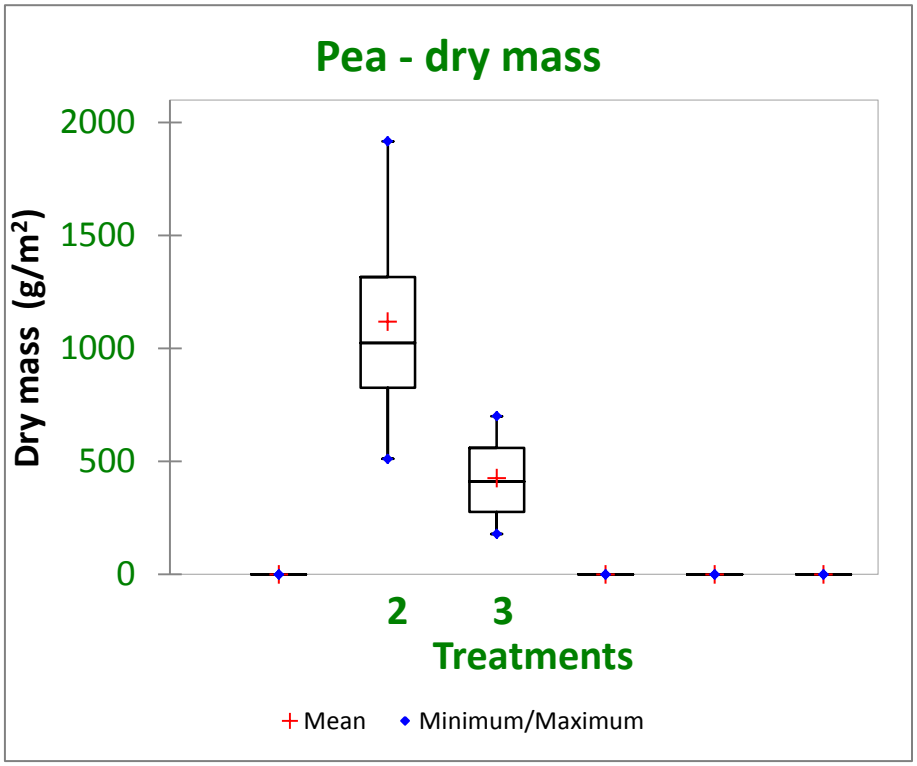
Dry mass of spring barley (21.07.2015)

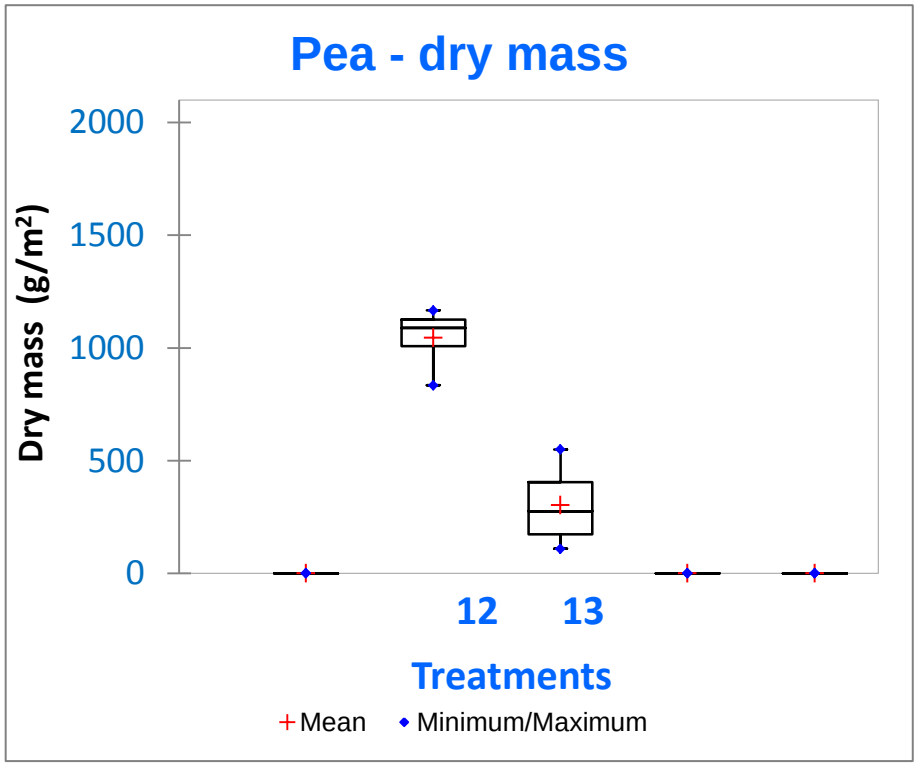




No treatments in systems		Crop species	Seeds rate
Organic	**IPM**		(No/m^2)
1	**11**	Spring barley	350
2	**12**	Pea	110
3	**13**	Spring barley + Pea	175 + 55
4	**-**	Without crop - *only natural weeds*	-
5	**15**	Spring barley	300
6	**16**	Spring barley	250

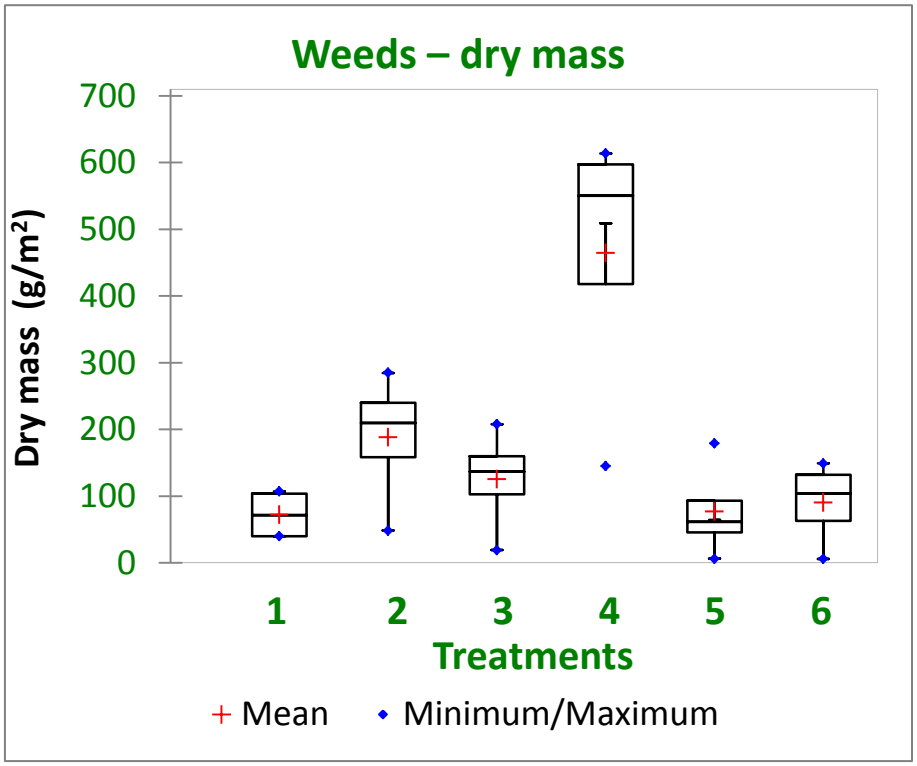
Dry mass of pea (21.07.2015)

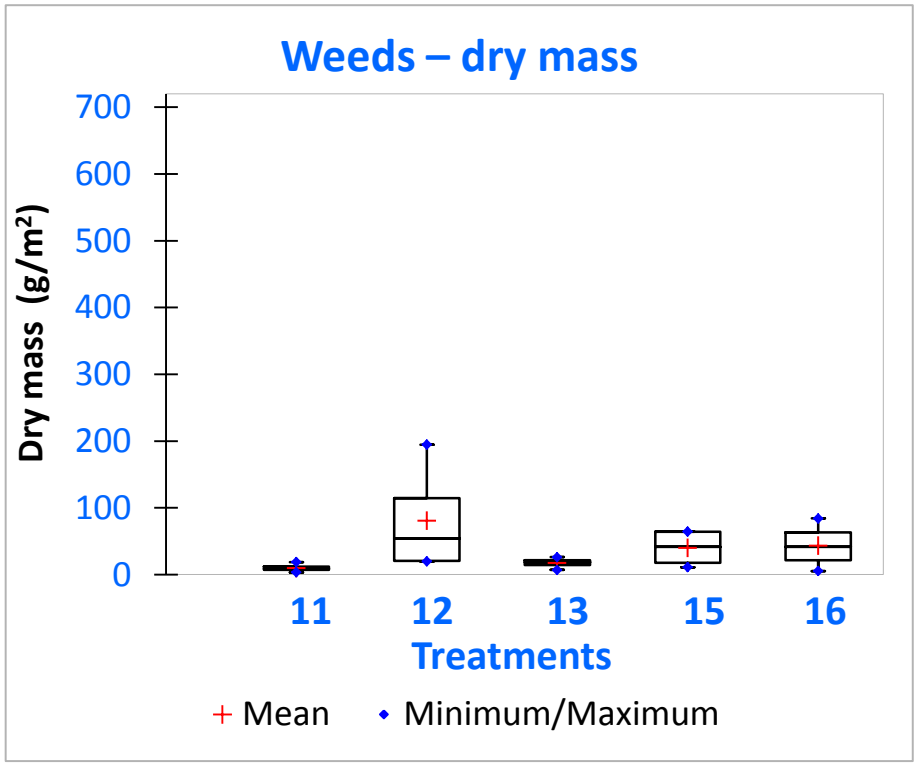




No treatments in systems		Crop species	Seeds rate
Organic	**IPM**		(No/m^2)
1	**11**	Spring barley	350
2	**12**	Pea	110
3	**13**	Spring barley + Pea	175 + 55
4	**-**	Without crop - *only natural weeds*	-
5	**15**	Spring barley	300
6	**16**	Spring barley	250

Dry mass of weeds (21.07.2015)





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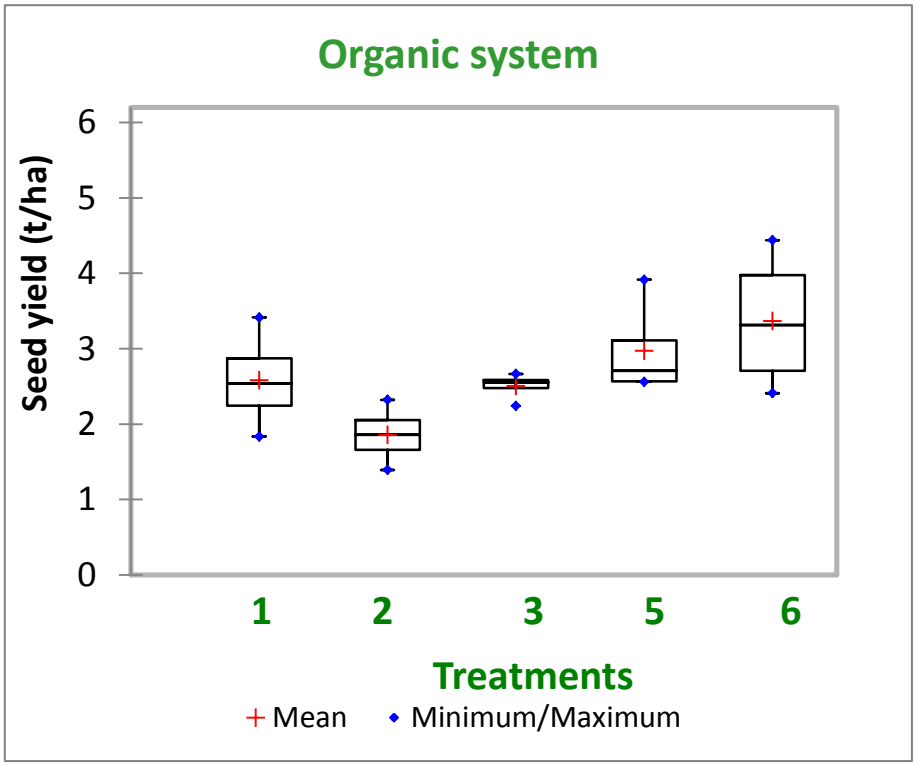
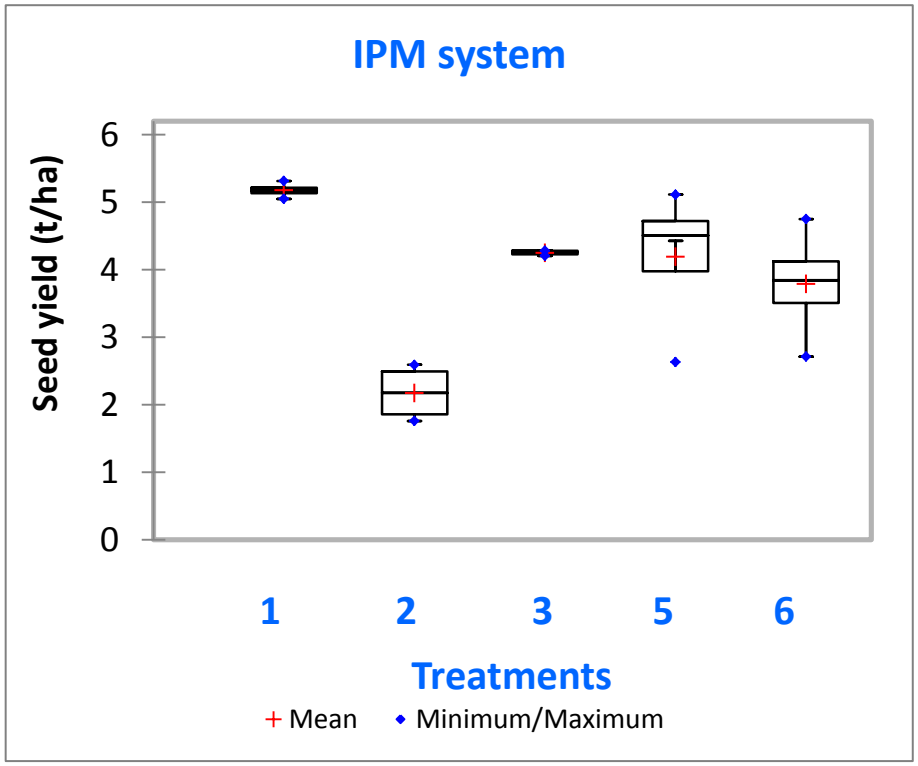
Organic	**IPM**		(No/m^2)
1	**11**	Spring barley	350
2	**12**	Pea	110
3	**13**	Spring barley + Pea	175 + 55
4	**-**	Without crop - *only natural weeds*	-
5	**15**	Spring barley	300
6	**16**	Spring barley	250

Field experiments – soil cover by weeds (%)

No tretments	Crop systems	Crop species	Seed rate No./m2	Soil cover by weeds (%)					
				AGRRE	CHEAL	ECHCG	EQUAR	MATIN	weeds total
1	**Organic**	**Spring barley**	**350**	3,3	2,9	-	15,0	0,03	21,2
2		**Pea**	**110**	2,3	3,3	-	2,5	0,03	8,1
3		**Spring barley + pea**	**50% / 50%**	4,8	2,6	-	1,3	-	8,6
4		**without crop - only natural weeds**	**-**	45,0	15,5	-	7,5	-	68,0
5		**Spring barley**	**300**	4,0	3,3	-	17,8	-	25,0
6		**Spring barley**	**250**	4,0	2,5	-	2,0	-	8,5
11	**IPM**	**Spring barley**	**350**	3,1	0,3	-	-	0,03	3,4
12		**Pea**	**110**	2,1	1,6	-	-	-	3,6
13		**Spring barley + pea**	**50% / 50%**	0,2	0,3	-	0,5	-	1,0
15		**Spring barley**	**300**	0,8	0,1	-	3,0	-	3,9
16		**Spring barley**	**250**	4,8	0,4	0,8	5,3	-	11,2

Seed yield





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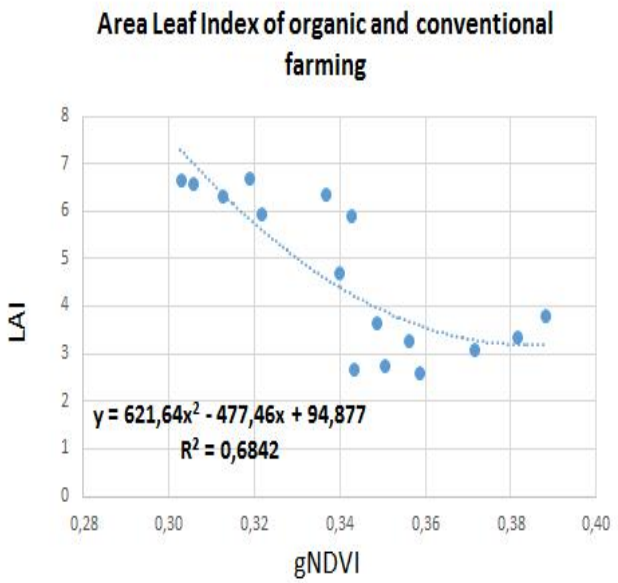
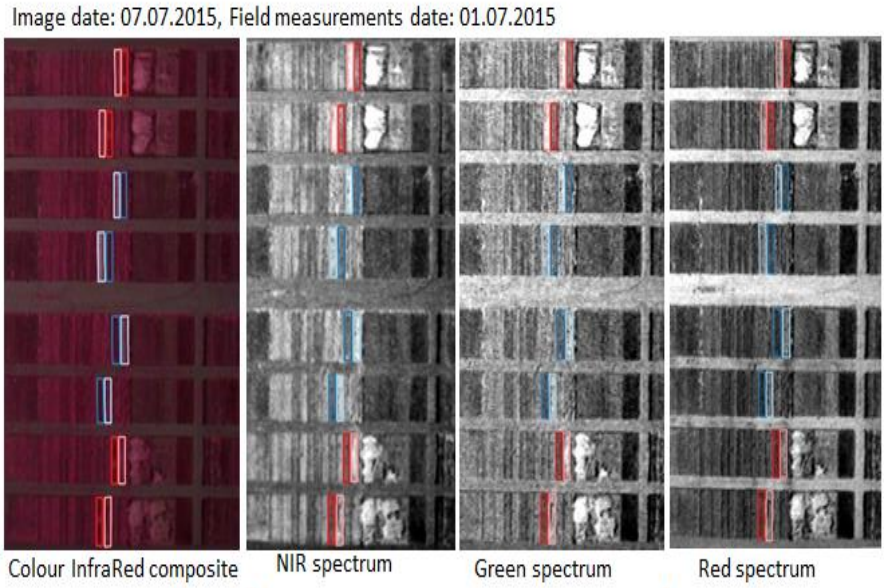
Green Normalised Vegetation Index assessment (spring barley, pea)

Photos taken and interpretation by IWING

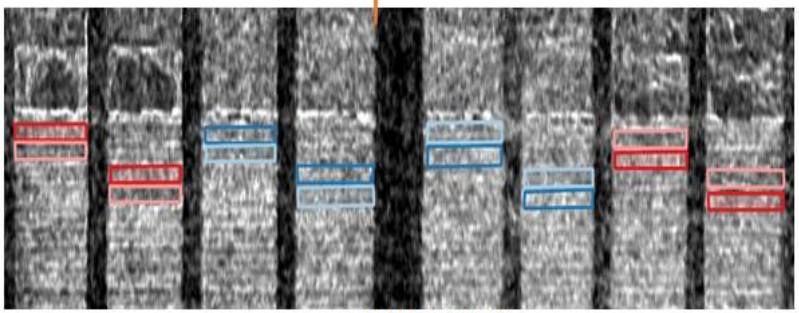
IWING Analysis of organic and conventional farming





The relationship between vegetation indexes and Area Leaf Index was determined. The Area Leaf Index was measured on experimental plots with barley and peas in two types of crops : organic and conventional .

The strongest correlation shows gNDVI (*Green Normalised Vegetation Index*) index . **Coefficient of determination amounts to $R^2 = 0.6842$ – which allows field measurements to be replaced by remote sensing photo data.**

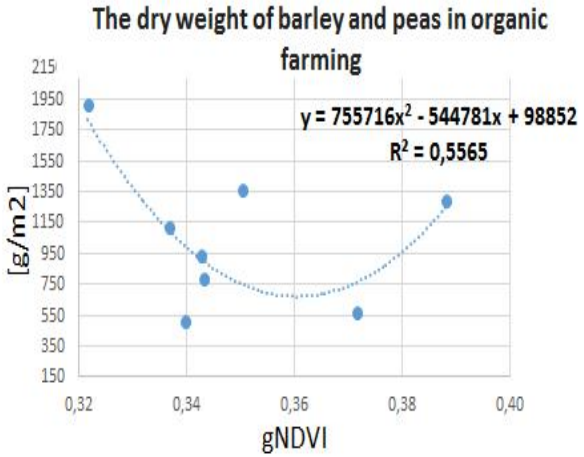


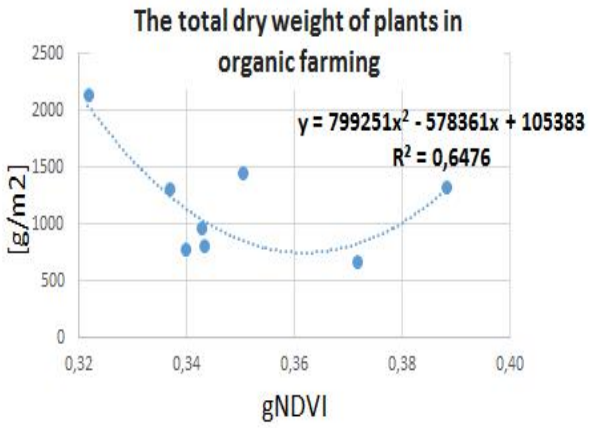
$$gNDVI = \frac{(NIR-GREEN)}{(NIR+GREEN)}$$

Green Normalised Vegetation Index assessment (spring barley, pea)

Photos taken and interpretation by IWING

IWING Analysis of organic farming –relationship between plants biomass and spectral data





$$gNDVI = \frac{(NIR-GREEN)}{(NIR+GREEN)}$$

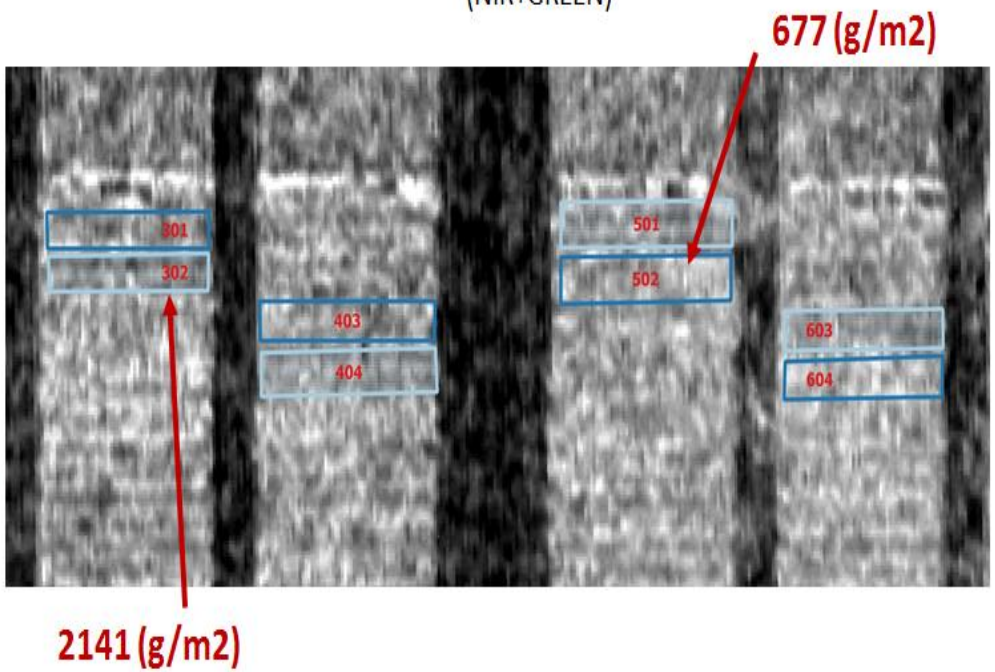
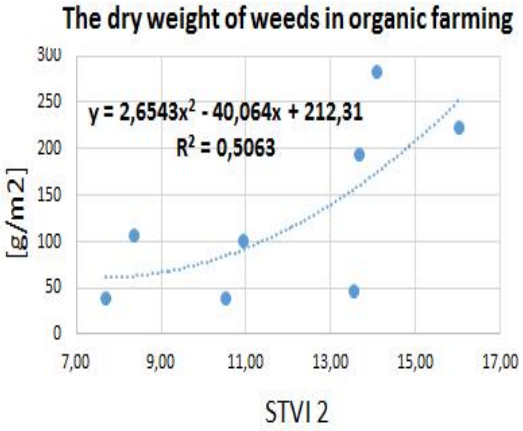


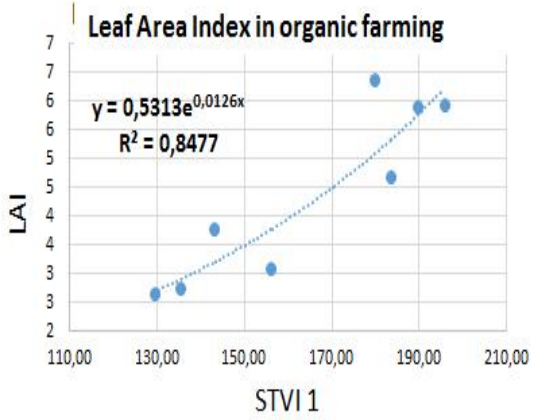
Image date: 07.07.2015
Field measurements date: 21.07.2015

Green Normalised Vegetation Index assessment (spring barley, pea)

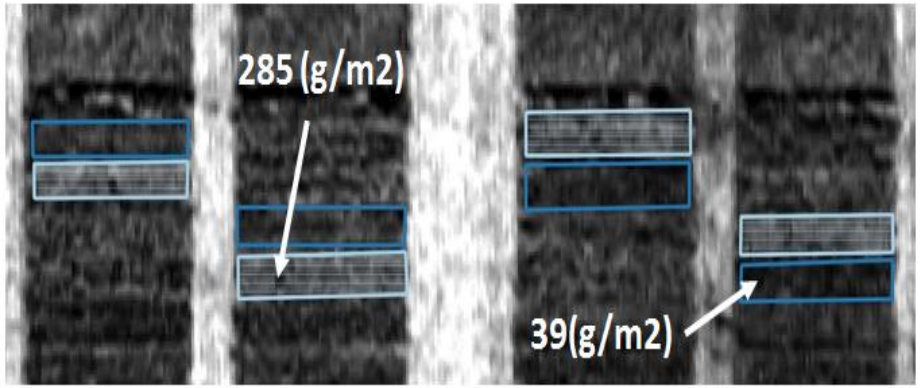
Photos taken and interpretation by IWING

IWING Analysis of organic farming –relationship between plants biomass and spectral data





$$STVI2 = \frac{(RED*GREEN)}{NIR}$$



$$STVI1 = \frac{(NIR*GREEN)}{RED}$$

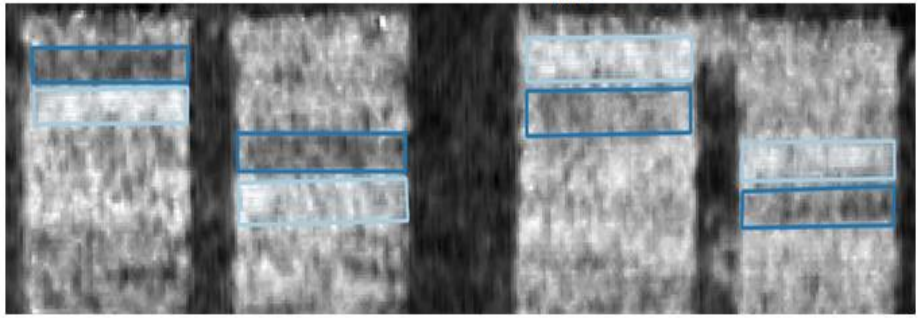
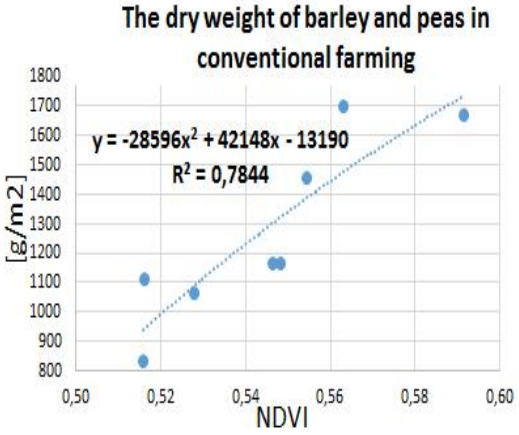


Image date: 07.07.2015, Field measurements date: 01.07.2015

*G*reen *N*ormalised *V*egetation *I*ndex assessment (spring barley, pea)

Photos taken and interpretation by IWING

IWING Analysis of conventional farming – relationship between plants biomass and spectral data



$$NDVI = \frac{(NIR-RED)}{NIR+RED}$$

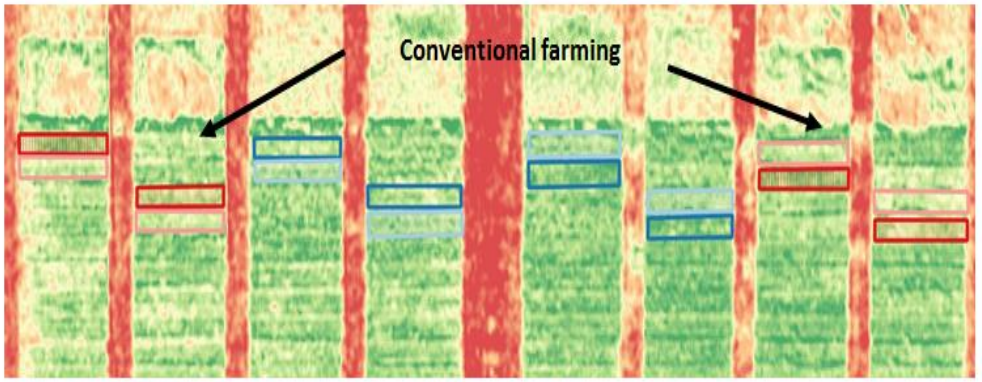
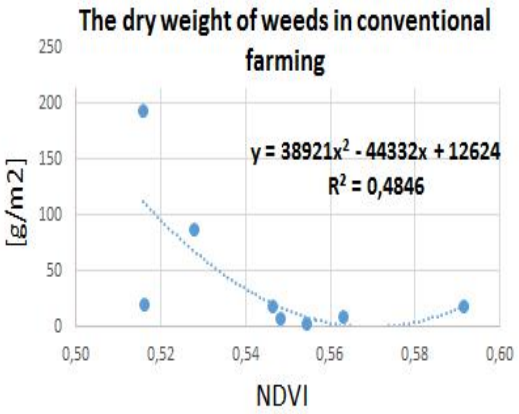
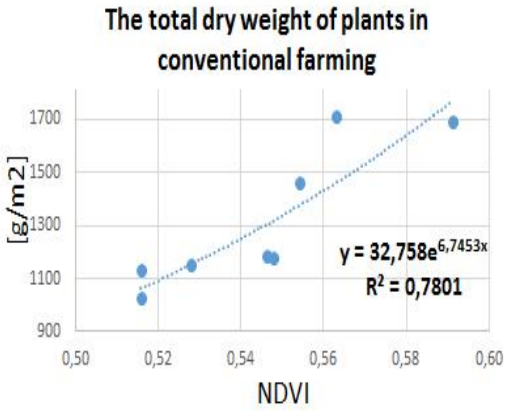


Image date: 07.07.2015, Field measurements date: 01.07.2015

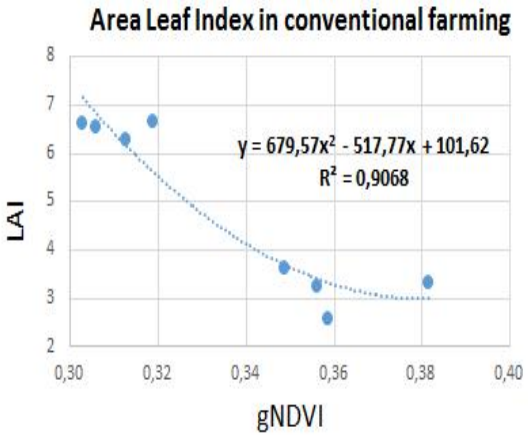




Green Normalised Vegetation Index assessment (spring barley, pea)

Photos taken and interpretation by IWING

IWING Analysis of conventional farming – relationship between plants biomass and spectral data



$$gNDVI = \frac{(NIR-GREEN)}{(NIR+GREEN)}$$

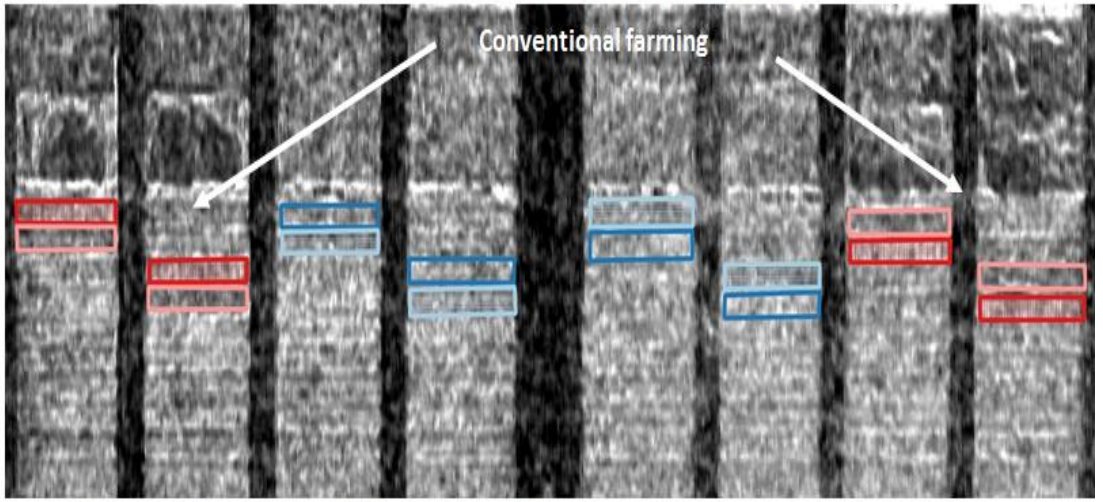


Image date: 07.07.2015, Field measurements date: 01.07.2015

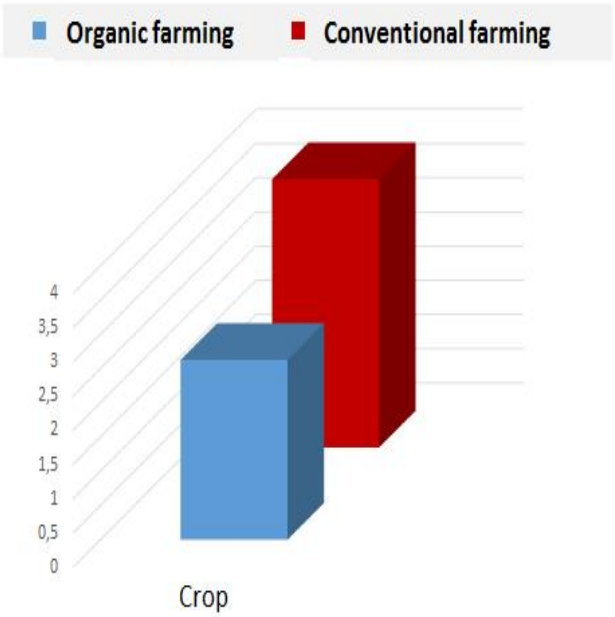
The relationship between vegetation indexes and Area Leaf Index was determined. The Area Leaf Index was measured on experimental plots with barley and peas in conventional farming .

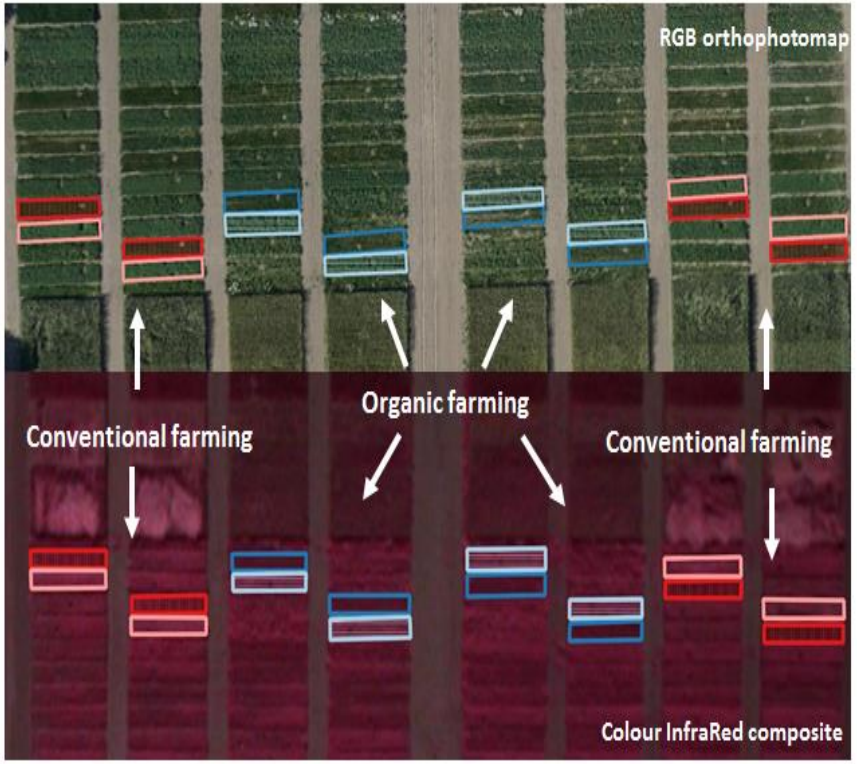
The strongest correlation shows gNDVI (*Green Normalised Vegetation Index*) index . Coefficient of determination is very high and amounts to $R^2 = 0.9068$. This analysis allows to draw conclusions that field measurements can to be replaced by remote sensing photo data.

Green Normalised Vegetation Index assessment (spring barley, pea)

Photos taken and interpretation by IWING

IWING Evaluation of the impact of two types of agriculture on crops





The analysis indicates that crops were 1,5 times higher in conventional farming rather than in organic.

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Glasshouse experiment

Glasshouse experiment (six replications)

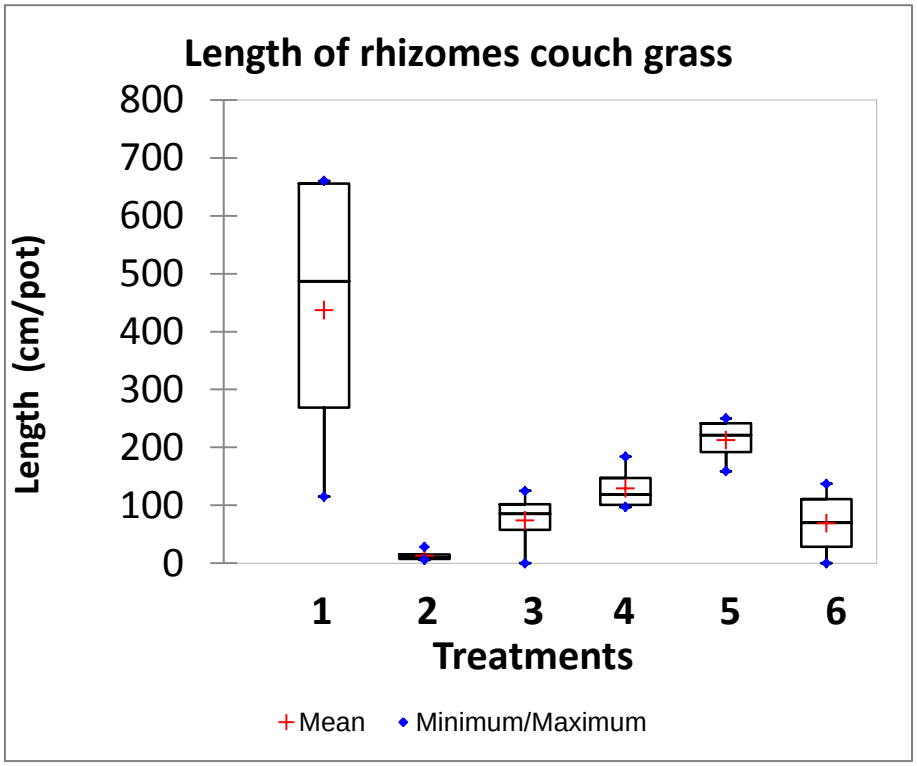
- **Series 1 (experiment completed)**
  - **1.** couch grass
  - **2.** couch grass + pure barley
  - **3.** couch grass + pure pea
  - **4.** couch grass + mixture of barley and pea 50% / 50%
  - **5.** couch grass + mixture of barley and pea 70% / 30%
  - **6.** couch grass + mixture of barley and pea 30% / 70%
- **Series 2 (experiment continues)**
  - **1.** couch grass
  - **2.** couch grass + pure barley
  - **3.** couch grass + pure peas
  - **4.** couch grass + mixture of barley and pea 50% / 50%
  - **5.** couch grass + mixture of barley and pea 70% / 30%
  - **6.** couch grass + mixture of barley and pea 30% / 70%
  - **7.** pure barley
  - **8.** pure pea
  - **9.** mixture of barley and pea 50% / 50%
  - **10.** mixture of barley and pea 70% / 30%
  - **11.** mixture of barley and pea 30% / 70%

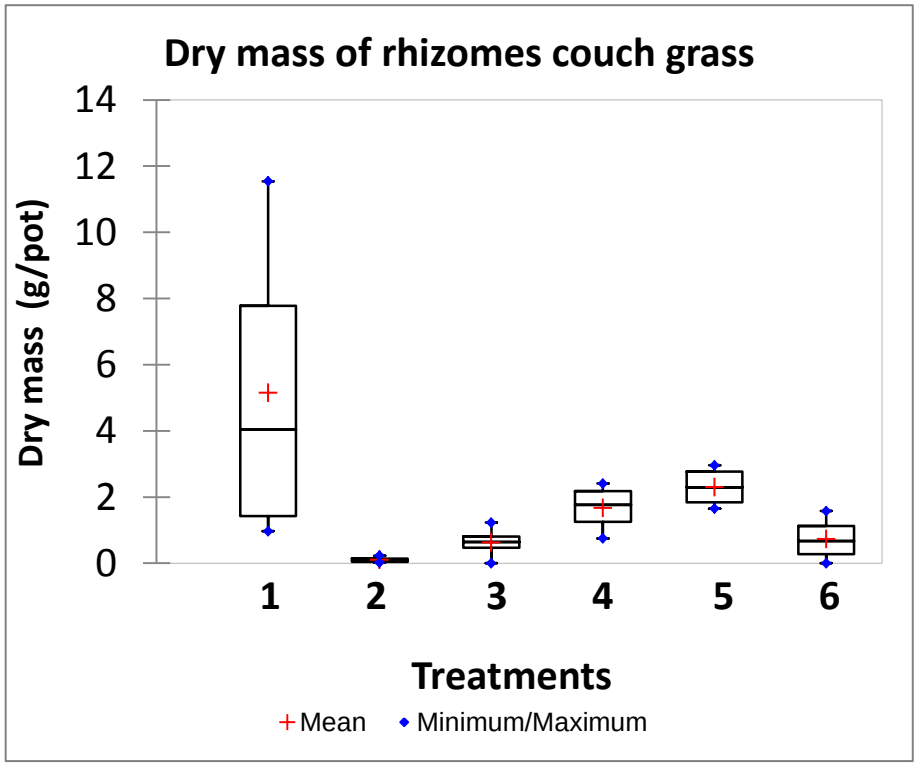
Glasshouse experiment

Analyses:

- Dry mass of crops and couch grass
- Couch grass rhizomes weight and length per unit
- Number and weight of seeds per unit
- Number of ears/grain and pods/seeds (No/pot)
- Yield quantity

Glasshouse experiment- *series 1*





1. couch grass
2. couch grass / pure barley
3. couch grass / pure pea
4. couch grass mixture: barley and pea 50% / 50%
5. couch grass /mixture: barley and pea 70% / 30%
6. couch grass / mixture: barley and pea 30% / 70%

Thank you for your attention