

Use of lime and fly ash stabilized biosolids as fertilizer substitute and to improve sodic soils



**P. Fine, U. Mingelgrin, A. Bosak
and many other**

**Inst. Soils, Water and Environmental
Sciences, Volcani Center, ARO,
P.O.Box 6, Bet-Dagan
50250, Israel**



Objectives are to present uses of lime stabilized biosolids (L&FASB) as:

- **fertilizer substitute and viable organic matter additive;**
- **means to control soil-borne diseases (in light-textured soils);**
- **means to remediate sodic soils (acid soils, RO water irrigation);**

Content of major constituents in sludges

Parameter	Shafdan sludge (untreated) ¹	Digested sludge (Ashdod, Sept 07)	Sludge compost Delila, (Sept 07)	ASB ² (Bet- Shemesh, avg 2007)	N-Viro Shafdan ³ (Nov. 2007)	CM ² (organic agric. at Yaham)
DM (%)	18	20	65	60	49	67
OM (%)	84 - 69	69	49	15.5	21 (30%)	
C (%)	49 - 31	36	23	8.2	12 (39%)	14.4
NH ₄ (%)	0.17 - 1.4	0.11	0.5	0.04	0.002	5,072
NO ₃ (mg/kg)			5			4
Total N (%)	7.1 - 5.9	5.1	2.3	1.2	1.6 (36%)	1.24
C _{org} /N _{Kjeldhal}	7.0 - 5.3	6.1	10	9	7.7	11.6
Total P (%)	3.8 - 1.9	3.2	1.5	0.5	0.7 (37%)	0.75
P _{Olsen} (%)	0.55	0.21	0.14	0.09	0.15	0.14
P _{Olsen} % of P _T	29	7	9.5	17	21	19
pH (1:5)				11.5	≥12	
EC dS/m (1:5)	1.9	5	4.5	5.5	7.3	

¹In red: 2006 average; in black: quality of the sample used to produce the N-Viro Shafdan.

²ASB: alkaline stabilized biosolids; CMC: cattle manure compost.

³in brackets: % of the concentration in the source sludge.



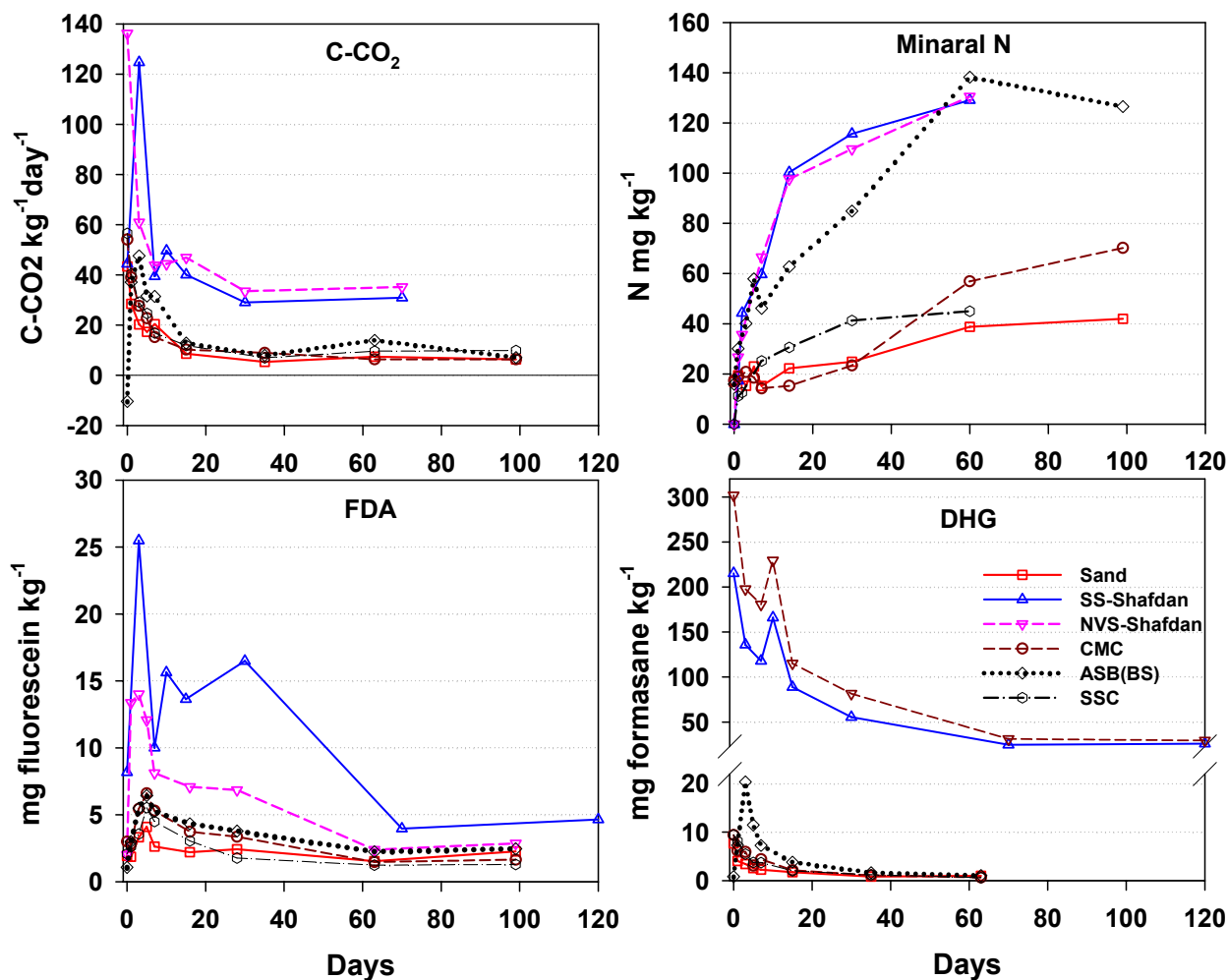
**2008/9 Chemical composition of some manures
(mg/kg)**

Parameter	ASB Bet (Shemesh)	Coal fly ash	SS compost (Delila)	Digested sludge (Raana)
Ag	0.9		5.1	10.5
Al	25,917		5,054	4,182
As	9.9		1.5	2.1
B	49		37	67
Ba	223		156	230
Ca	258,885		41,787	32,944
Cd	1.29		0.65	1.07
Co	4.4		2.2	2.2
Cr	190		67	61
Cu	72		174	266
Fe	14,617		5,559	3,639
K	8,842		3,499	5,992
Li	23.3		2.3	2.0
Mg	3,742		5,671	5,778
Mn	35		71	91
Mo	7.43		2.77	4.09
Na	3,211		1,147	1,587
Ni	101		19	22
P	7,518		10,767	20,857
Pb	26		27	27
S	31,541		5,072	10,049
Se	16.1		0.8	3.0
Sr	967		145	123
V	218		12	13
Zn	286		617	1,280

* Wastewater: conc. of remain trace elements and heavy metals was below limit of detection (10ug/l)

Results from a lab comparative study on the effect of lime & fly ash stabilization on the biological activity of the stabilized sludge

Lab incubation experiment with sludge-sand mixtures, each at same application rate on total N basis, equivalent to 500 kg N ha⁻¹. Presented are: (1) rate of CO₂ emission into the head space, (2) accumulation of mineral N in the incubation mixture, and two microbial activity parameters: (3) Dehydrogenase activity, and (4) FDA. SS: Shafdan untreated sludge (γ -irradiated), NVS: alkaline stabilized SS, ASB: alkaline stabilized Bet-Shemesh sludge, SSC: sewage sludge compost (Delila site), CMC: cattle manure compost (Yaham, organic agric.)



A field experiment where 3 sludge types were tested for their effect on crops (corn followed by wheat) yield, quality and chemical composition and the distribution of nutrient elements in the soil profile.

**Sludges as fertilizer substitutes: Revadim field experiment
Silage corn (summer 2008) and hay wheat (2008/9)**

Wheat (hay) Kg dry/ha	Silage corn tons/ha	Fertilizer application (4/2008) (kg ha ⁻¹) [§]			Treatment
		N head dress.	Sludge min N	N-P-K base	
2,720 b	12.7 b	24	-	0-0-0	1) No N
3,980 ab	17.6 ab	24	-	150-50-50	2) Base N only
3,770 ab	16.7 ab	174	-	0-0-0	3) Head dressing N
3,560 ab	19.3 a	174	-	150-50-50	4) Commercial N
4,070 ab	21.8 a	174	30	420 - 320- 40	5) Class B sludge (8 t/ha)
3,680 ab	22.5 a	174	100	720-1040-170	6) SS compost (18 tons/ha)
4,600 a	21.0 a	174	7	490-1360-770	7) ASB (63 tons/ha)

[§]The three sludges (treatments 5-6) were applied to supply ca. 500 kg N ha⁻¹.
Fertilizer units (in kg ha⁻¹): N as N, P as P₂O₅, K as K₂O

Reduction of soil borne diseases using Alkaline Stabilized Biosolids and ammonia (as ammonium sulfate)

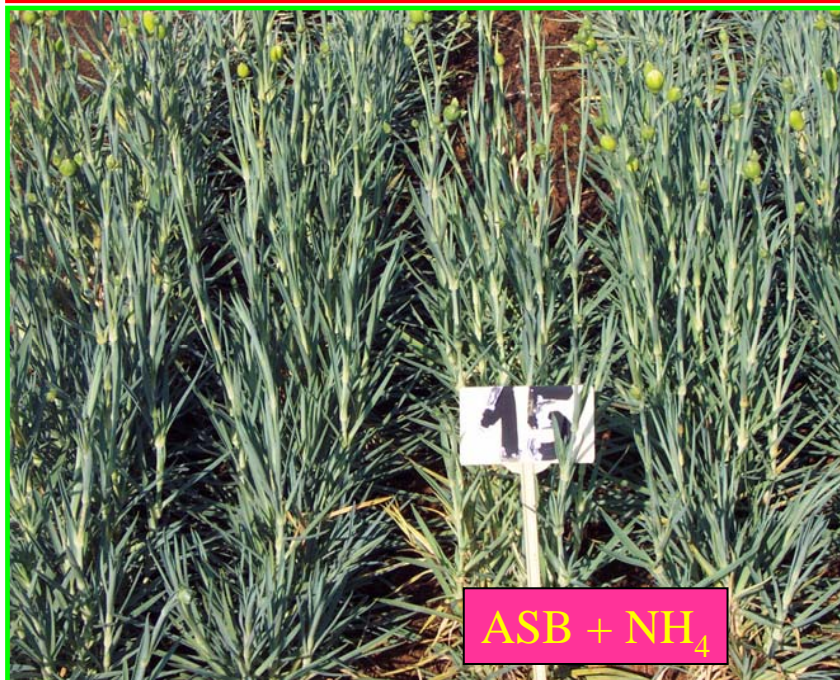
(in collaboration with U. Zig, N. Borgan, A. Gips, G.
Kritzman, Y. Ben-Yephet, M. Reuven, B. Kirshner)

***Fusarium oxysporum* reduction in soil and alleviation of fusarium wilt in carnations – a micro-plot experiment**



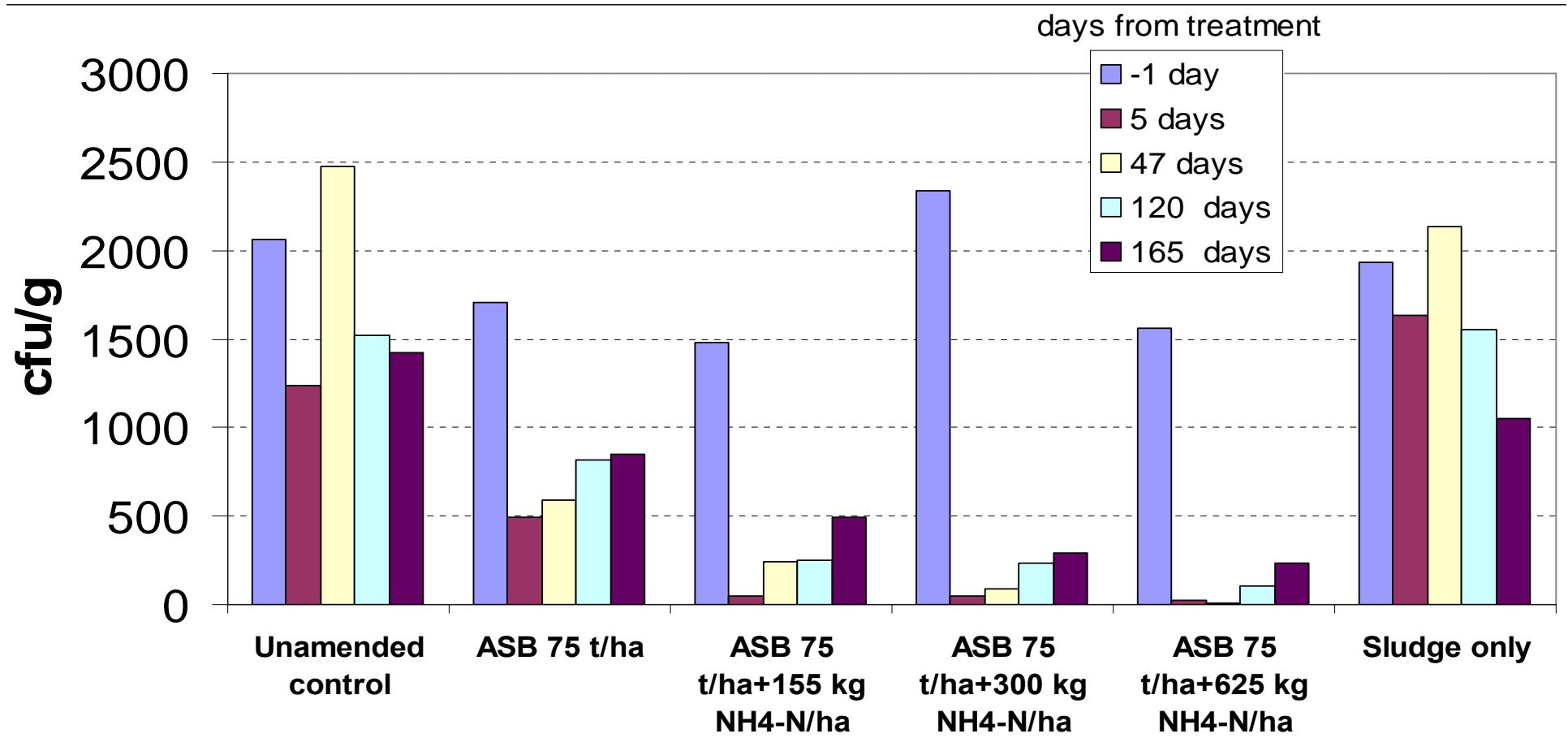


Unamended control



ASB + NH₄

Effect of ASB+NH₄ application to the 0-20 cm layer of infested red Mediterranean sand on viability of *Fusarium oxysporum dianthi* (averages of 8 replicate plots)

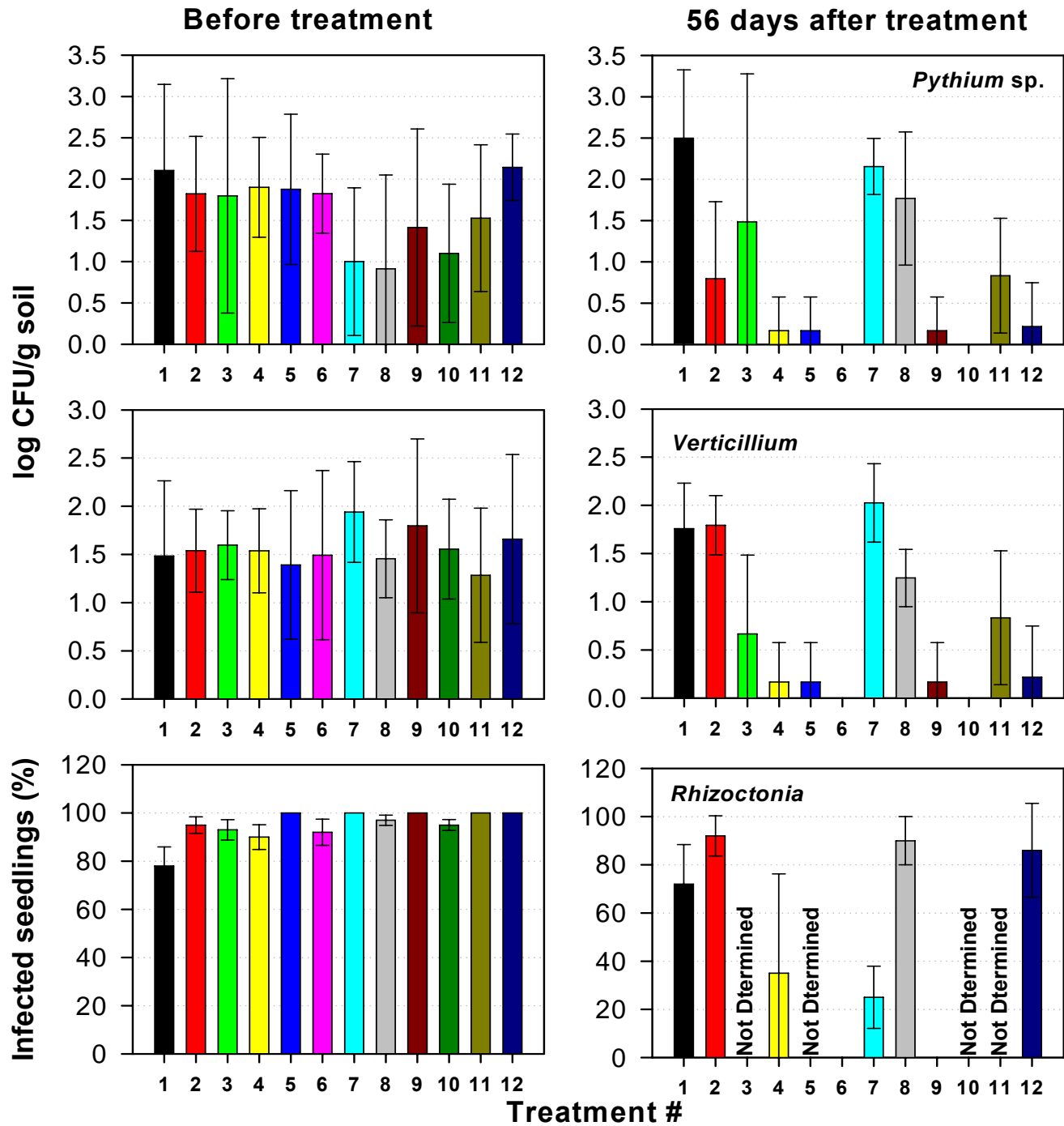


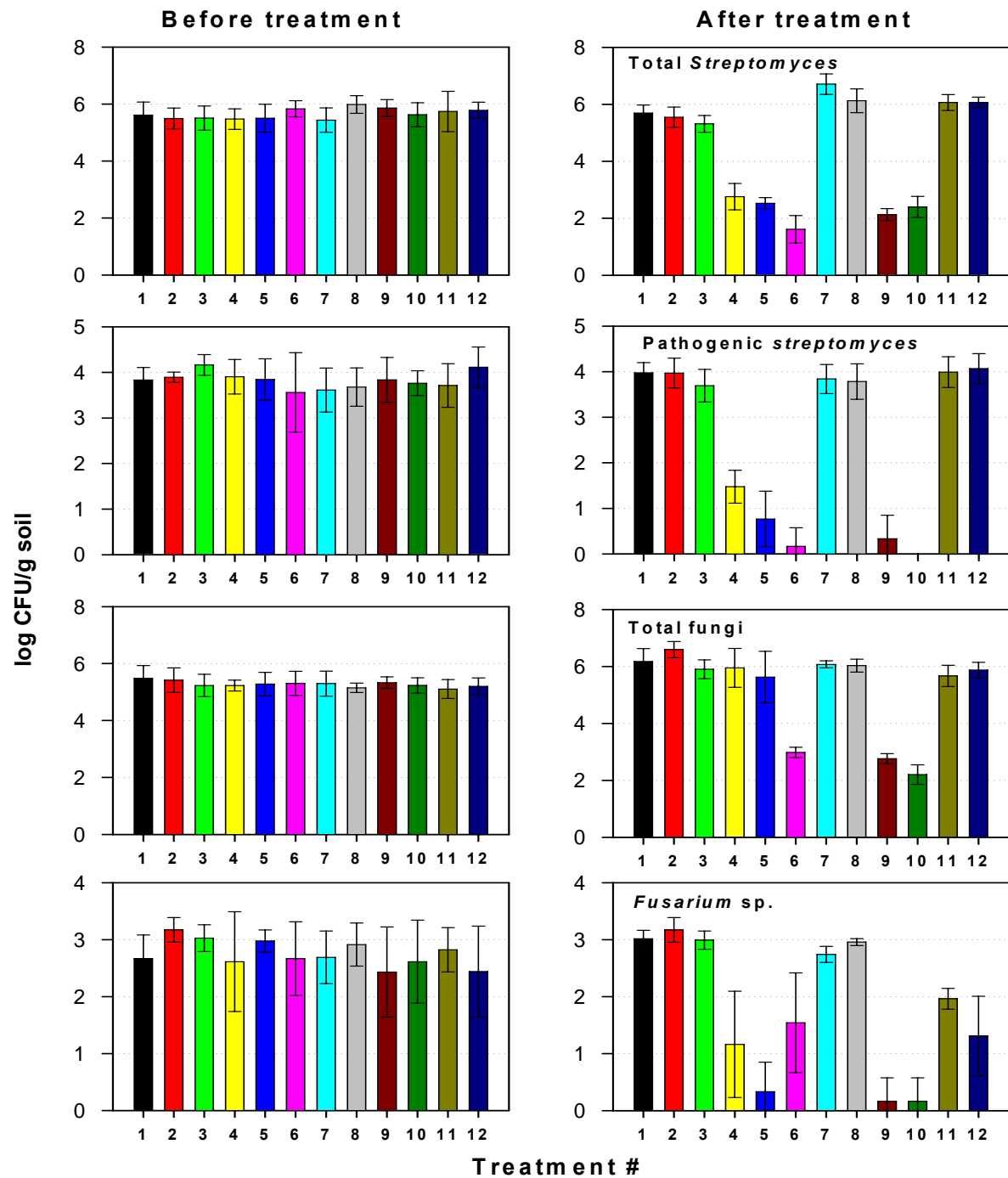


Control of *Fusarium oxysporum dianthi* in cucumbers in the greenhouse on light textured soil using ASB + 250 kg NH₄-N/ha before planting

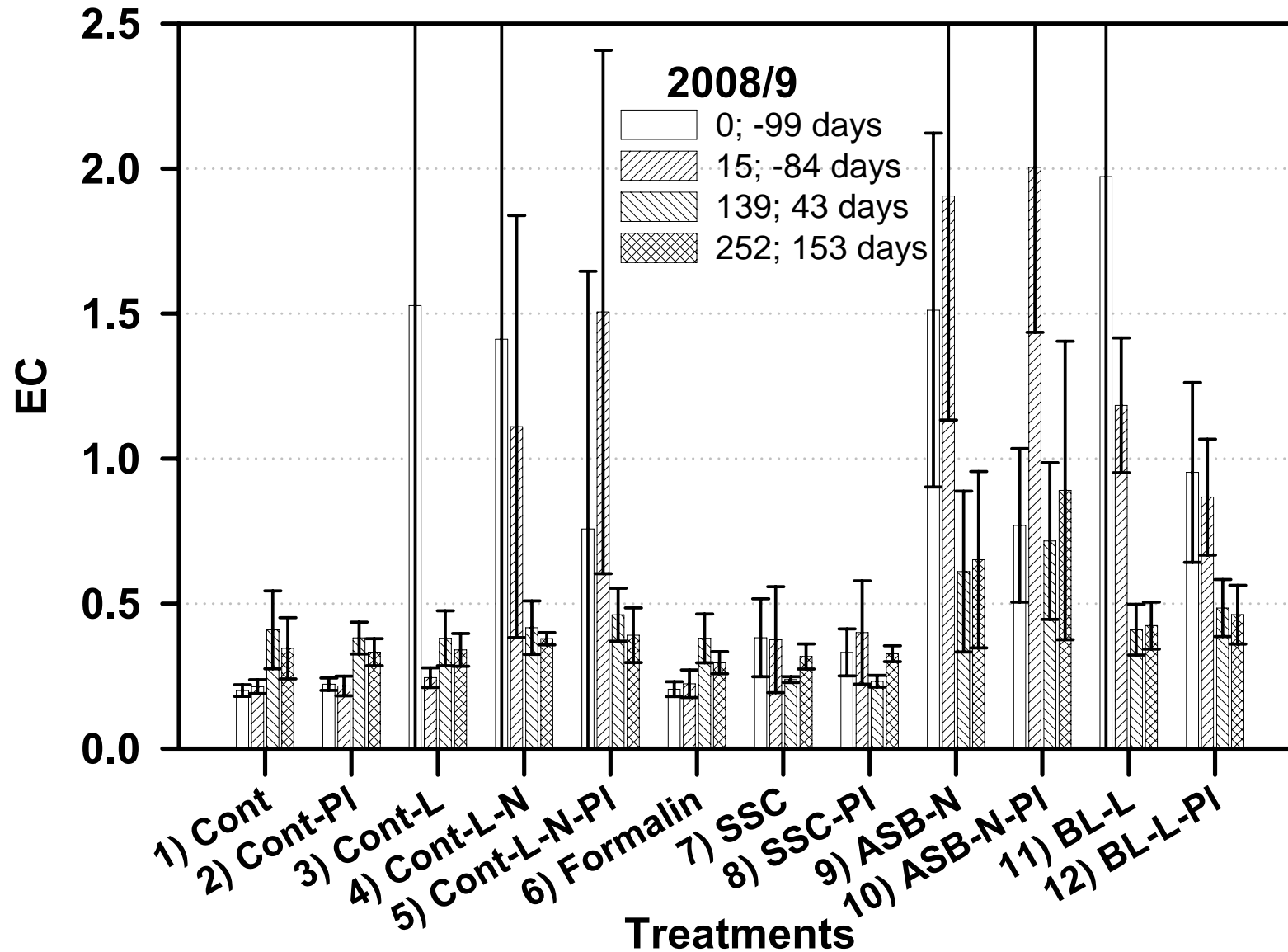
Soil disinfection experiment in the NW Negev at Nir-Yitzhak on a sandy soil. Potatoes were sown ca. 3 months after treatment.

Treatment # & code		ASB	SSC	Broiler litter	Slaked lime	(NH ₄) ₂ SO ₄	Plastic	
		m ³ /ha	m ³ /ha	tons/ha	tons/ha	tons/ha	cover	
1	Cont	-	-	-	-	-	-	
2	Cont-Plastic	-	-	-	-	-	+	
3	Cont-Lime	-	-	-	5	-	-	
4	Cont-L-NH4	-	-	-	5	1.5	-	
5	Cont-L-NH-PI	-	-	-	5	1.5	+	
6	FormAld	Conventional disinfection with formaldehyde						
7	SSC	-	50	-	-	-	-	
8	SSC-plastic	-	50	-	-	-	+	
9	ASB-NH4	100	-	-	-	1.5	-	
10	ASB-NH4-Plastic	100	-	-	-	1.5	+	
11	Broiler-Lime	-	-	30	5	-	-	
12	Broiler-Lime-Pla	-	-	30	5	-	+	





Effect of lime and ASB amendments on soil salinity (1:2 soil:water extract of the 0-20 cm layer)



Treatment effect on potatoes tuber yield (TK HSD at P<0.05)

Treatments	Tuber uield (kg/0.1ha)	N mg/kg	St- dev	P mg/kg	St- dev	K mg/kg	St- dev
1) Cont	4,064 a	17,590	1,265	2,305 a	173	25,784	1,339
2) Cont-Plastic	4,268 a	16,985	1,169			25,636	1,725
3) Cont-Lime	3,853 ab	16,811	1,860			26,694	1,215
4) Cont-L-NH ₄	3,799 ab	16,748	873	2,151 ab	141	25,785	1,564
5) Cont-L-NH ₄ -PI	3,658 abc	16,005	1,015			25,032	1,695
6) FormAld	4,145 a	16,781	1,566			26,090	1,712
7) SSC	4,412 a	16,543	1,590	2,147 ab	247	24,881	1,660
8) SSC-plastic	4,294 a	16,057	773			25,480	1,058
9) ASB-NH ₄	2,898 cd	15,239	1,456	1,803 b	43	25,780	683
10) ASB-NH ₄ -Plastic	2,280 d	15,028	642			25,482	1,452
11) Broiler litter-Lime	4,186 a	16,733	1,025	2,461 a	450	25,638	1,999
12) Broiler litter Lime-Plastic	3,275 bc	17,108	1,484			25,027	1,095

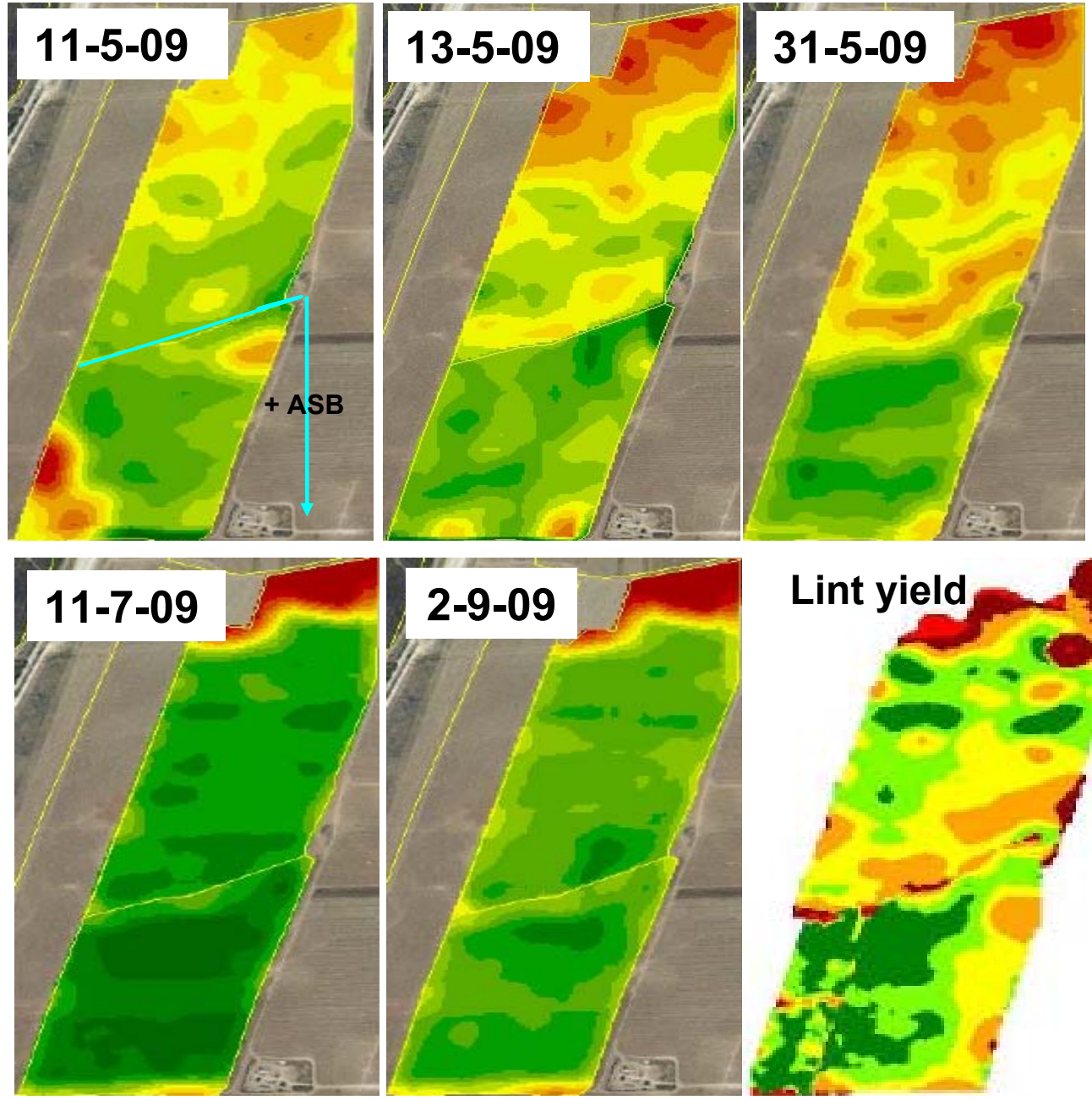
Using ASB to improve sodic soils

Field trial:

**ASB application to natric vertisol
(kibbutz Revadim) improved water
availability to cotton plants and
increased lint yield.**

**Green color signifies better plant development
and higher yield**

(In collaboration with G. Levy and Y. Kilmann)



Summary of presentation on uses of lime stabilized biosolids (L&FASB):

- **There are indeed benefits in using this product in agriculture.**
- **There are however potential pitfalls mainly with respect to the high initial pH and the load of salinity that comes with it (especially at disinfection loads).**
- **Research and observations tests are yet needed.**



**Thank you for
your attention**