Ongoing Research Projects

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VIRGINIA TECH™

Anaerobic soil disinfestation 3-Steps

- Incorporate organic material (Optimal C:N 20:1 to 30:1, recommend C rate 4mg/g soil).
- Cover with oxygen impermeable tarp.
- Irrigate to field capacity.

ASD effects

ASD has proved to be **effective against** several soil-borne fungal and bacterial plant diseases, plant-parasitic nematodes and weeds:

- *Phytophthora* (Rosskopf *et al*. 2016)
- *Pythium spp* (Hewavitharana *et al*. 2014)
- *F. oxysporum* (Momma *et al*. 2010)
- *V. dahliae* (*Shennan et al. 2018*)
- *Rhizoctonia. solani* (Hewavitharana *et al*. 2014)
- Yellow nutsedge (*Cyperus esculentus*) (Shrestha *et al.*2018)
- Root-rot nematode (*Meloidogyne sp*.) (Gioia *et al. 2016*)

ASD mechanisms

- Accumulation of **toxic/suppressive products** deriving from the anaerobic decomposition (e.g. organic acids, volatile organic compounds)
- **Biological control** by facultative anaerobic microorganisms
- Low pH
- Low oxygen
- Generation of Fe^{2+} and Mn^{2+} ions
- **Combination of all of these**

ASD: Carbon sources

- Japan: Rice bran, wheat bran, **ethanol .**
- California: **Rice bran** (4.5 to 9 t/acre), mustard cake, mustard seed meal, almond hulls.
- Florida: **Liquid molasses**, cover crop residue.
- Tennessee: **Dry molasses**, cover crop residue, wheat bran.
- The Netherlands: Grass, potato haulms, crop residues.

Weed control assessment of various carbon sources for anaerobic soil disinfestation

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ABSTRACT

Greenhouse trials were conducted to evaluate the effect of several locally available carbon (C) sources on weed suppression using anaerobic soil disinfestation (ASD). Carbon sources included rice bran, sorghum-sudangrass, cowpea, buckwheat, paper mulch, brewer`s spent grain, waste coffee grounds and peanut shells applied at 4 mg of C/g of soil. All trials were conducted in containers of 0.2-m height and 0.15-m diameter. The germination of common chickweed, redroot pigweed, white clover and yellow nutsedge was reduced similarly with all C sources used for ASD. The addition of distiller's yeast at 10 kg/ha to C sources at 4 mg of C/g of soil provided similar or better weed control than ASD treatments with C sources alone. ASD treatments in all trials reduced weed viability from 38 to 100% compared to the non-treated control. Redox potential in all ASD treatments during the 3-week treatment was lower (more anaerobic) than the non-treated control.

Keywords. Brewer's spent grain, cover crops, distiller's yeast, ethanol, paper mulch

Hypotheses

❖Enhance ASD effect

Hypothesis: distilled yeast could enhance the efficiency of carbon sources in achieving ASD.

1. Bioethanol fermentation could be conducted in field using forage crop with enzymes (Honda et al.,2008 and Kitamoto et al., 2011).
2. Residual organic substances in the bioethanol fermentation products enhanced the effect of the ASD treatment (Horita & Kitamoto, 2015).
3. BSG could be used to produce bioethanol (Liguori et al, 2015).

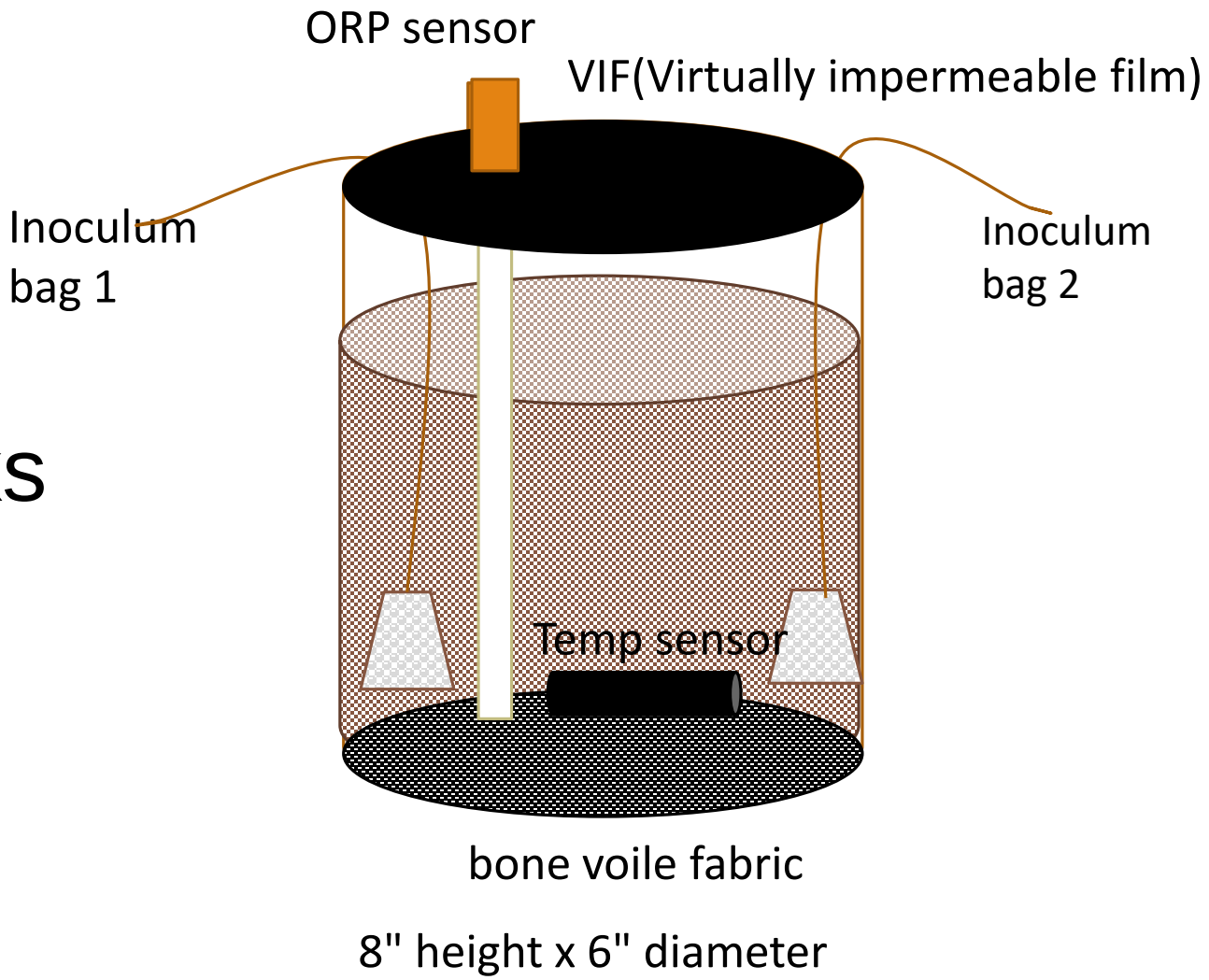
Trial 1 **Evaluation of BSG ± yeast**

1. Brewer`s spent grain 64g/pot
2. Brewer`s spent grain 64g/pot + yeast 0.06g
3. Rice bran 63g/pot
4. Rice bran 63g/pot + yeast 0.06g
5. Non treated control
6. Non-treated control + yeast 0.06g

Experimental design

Greenhouse trial

- Completely Randomized Design
- Four replicates
- Experiment period: 3 weeks



Measurements

- **Redox Potential (Eh)**

Cumulative soil anaerobicity (mV · hr)

=∑|Eh-CEh(critical redox potential)|

- **Temperature**

* Data were recorded every hour for 3wks

❖Inoculum bags

Yellow nutsedge *(Cyperus esculentus)*	10 tubers/bag
White clover (*Trifolium repens)*	100 seeds/bag
Redroot pigweed (*Amaranthus retroflexus*)	100 seeds/bag
Common chickweed(*Stellaria media*(L.) Vill.)	100 seeds/bag
Pythium irregulare	1 colonized substrate

*The non-germinated seeds were treated by Tetrazolium Chloride (TZ) test, and then counted.

The *Pythium* solution samples were spread to modified PARP medium and counted the colony-forming unit per g soil.

Statistic Analysis

- ANOVA ,LSD ($\alpha<0.05$) or Wilcoxon test
- JMP
- Microsoft Excel program
- Origin Pro 2016

Trial 1	Weed germination rate (%)					Cumulative soil anaerobicity (mV hr)
	Pigweed	Chickweed	Clover	Nutsedge	Pythium (CFU/g)	
BSG 64g	27.0 b	21.0 c	21.0 b	2.5 b	51 b	183707
BSG 64g + 0.06g yeast	15.0 c	14.0 d	11.0 c	0 b	28 c	175922
Rice bran 63g	23.0 b	24.0 c	13.0 c	0.0 b	53 b	144827
Rice bran 63g + 0.06g yeast	20.0 c	18.0 c	15.0 c	0.0 b	52 b	96571
Nontreated	74.0 a	73.0 a	82.0 a	75.0 a	164 a	5023*
Nontreated + 0.06g yeast	68.0 a	65.0 b	78.0 a	70.0 a	172 a	4214*

*wilcoxon test , all P<0.001

Trial 2 **Evaluation of reduced rate BSG ± yeast**

1. Brewer`s spent grain 64g/pot
2. BSG half rate,32g/pot,
3. BSG half rate, 32g/pot + yeast 0.03g
4. BSG 1/3 rate, 21g/pot
5. BSG 1/3 rate, 21g/pot + yeast 0.02g
6. Non treated control
7. Non-treated control with yeast 0.06g

Trial 2	Weed germination rate (%)					Cumulative soil anaerobicity (mV hr)
	Pigweed	Chickweed	Clover	Nutsedge	Pythium (CFU/g)	
BSG 64g	19.0 c	17.0 d	25.0 c	3.0 c	9.3 e	315681
BSG 32g	48.0 b	31.0 b	47.0 b	9.0 c	17.5 c	273704
BSG 32g w yeast	19.0 c	21.0 cd	25.0 c	9.0 c	14.0 d	223309
BSG 21g	44.0 b	33.0 b	44.0 b	20.0 b	13.8 d	142430
BSG 21g w yeast	22.0 c	24.0 cd	25.0 c	6.0 c	12.4 d	321989
Nontreated	73.0 a	70.0 a	77.0 a	73.0 a	37.4 a	22198*
Nontreated w yeast	75.0 a	75.0 a	74.0 a	66.0 a	29.5 b	59084*

*wilcoxon test , all P<0.0001

Treatments, Small-Scale Field Trial

1 Fumigant (Pic-Clor-80, 175 lb/acre)

2 Brewer`s Spent Grain 6 ton/acre + Yeast

3 Brewer`s Spent Grain 3 ton/acre soil + Yeast

4 Brewer`s Spent Grain 6 ton/acre soil No Yeast

5 Brewer`s Spent Grain 3 ton/acre soil No Yeast

6 Non-treated + Yeast

7 Non-treated No Yeast

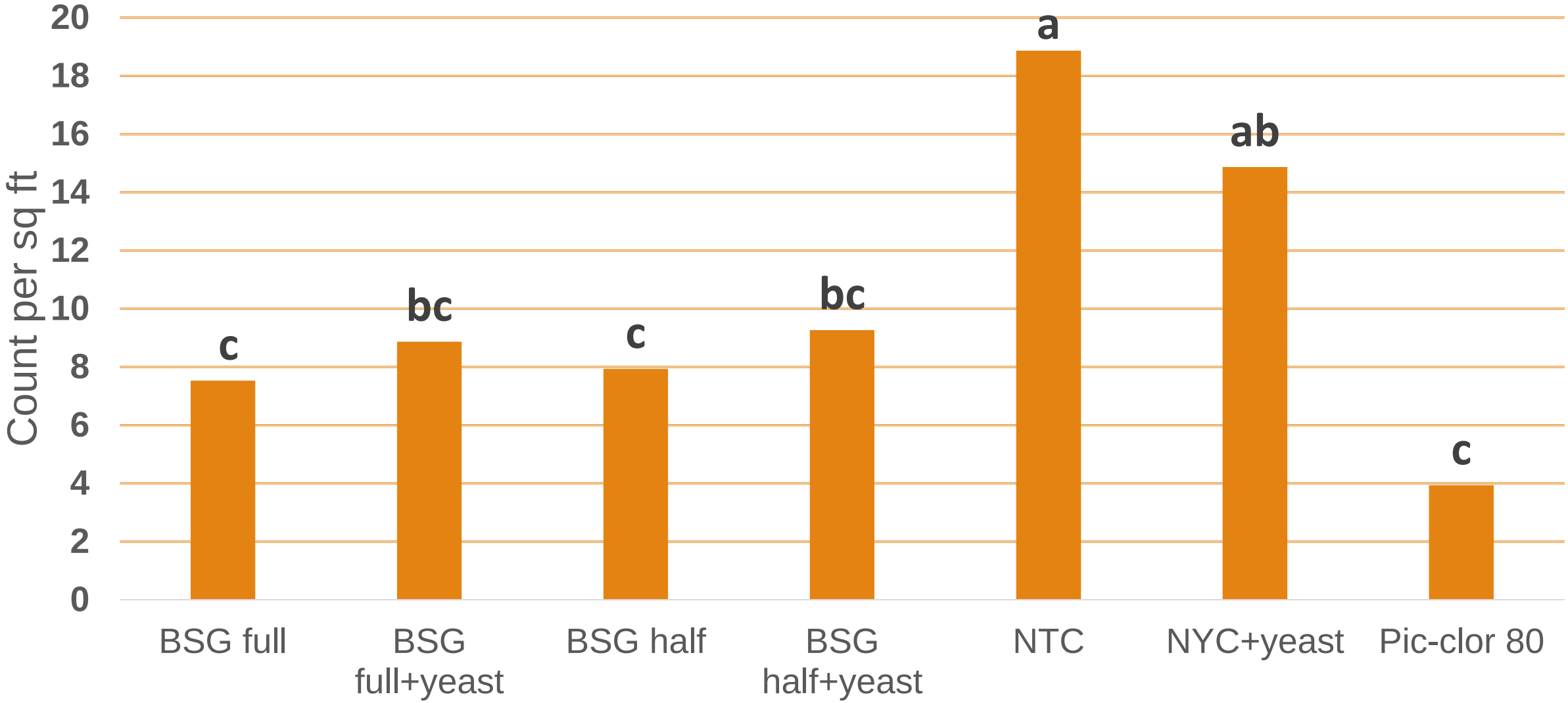
* Yeast application rate: 9.1 lbs/acre, cost $72.8/acre

Brewer`s spent grain could get for free

Weed species that was detected through viewing windows :

- Shepherd`s Purse (*Capsella bursa-pastoris*)
- Bermuda (*Cynodon dactylon*)
- Crabgrass (*Digitaria sanguinalis*)
- Carpetweed (*Mollugo verticillata*)
- Yellow Nutsedge (*Cyperus esculentus*)
- Wild Garlic (*Allium ursinum*)
- Henbit (*Lamium amplexicaule*)
- Common Purslane (*Portulaca oleracea*)
- Carolina Geranium (*Geranium carolinianum*)
- White Clover (*Trifolium repens*)
- Cudweed (*Gnaphalium spp.*)
- Common knotweed (*Polygonum arenastrum*)

Cumulative weed count from field trial

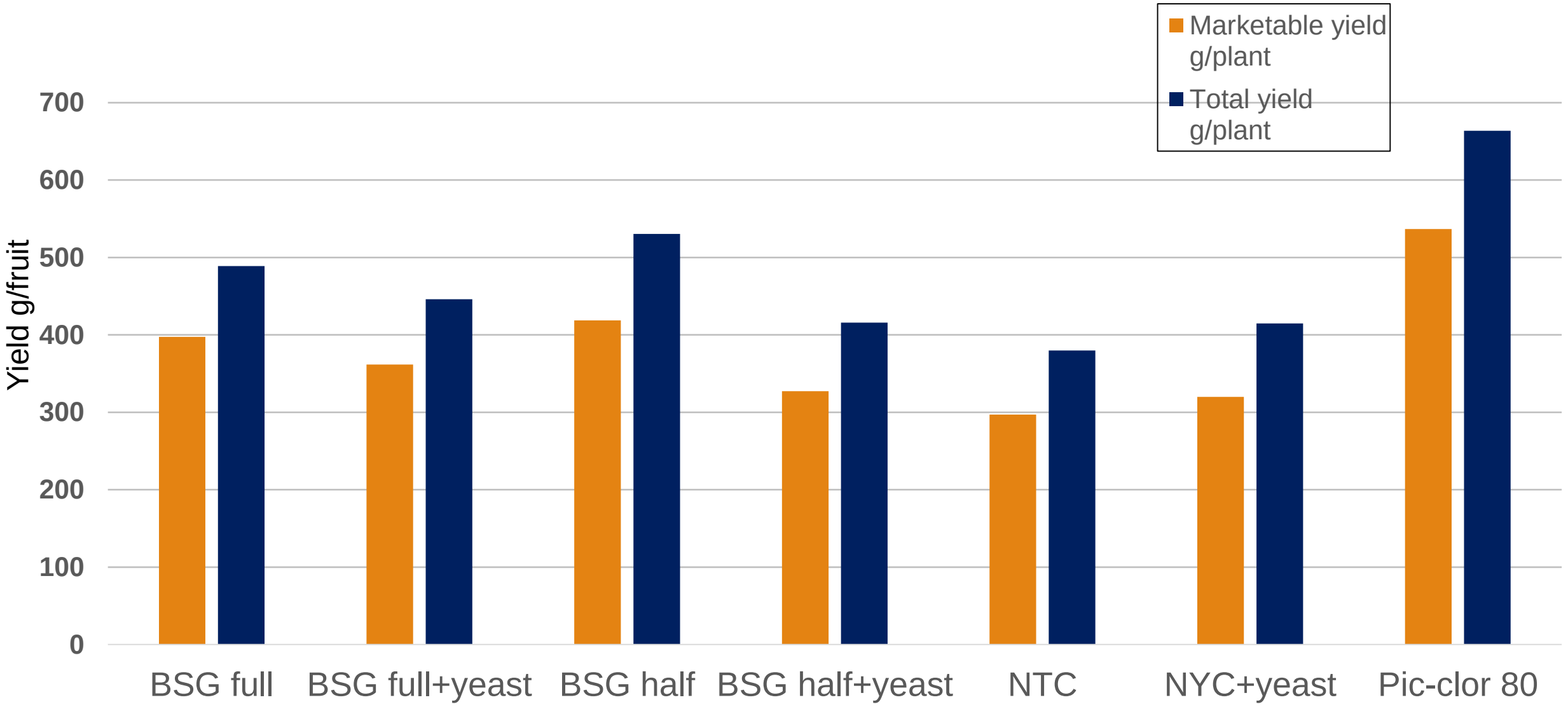


Total count of the dominant weed species.

Treatments	Shepherd`s Purse	Crabgrass	Yellow Nutsedge	Carolina geranium
BSG full	1.8 b	5.8 bc	4.5 abc	11.3 cd
BSG full+yeast	3.8 b	7.5 bc	2.3 bc	6.5 d
BSG half	1.3 b	11.8 ab	3.3 bc	12.3 cd
BSG half+yeast	32.3 ab	10.0 ab	2.0 c	15.0 bcd
Control	49.8 a	17.0 a	9.0 a	32.8 a
Control+yeast	41.3 a	17.5 a	7.5 ab	22.5 abc
Pic-Clor-80	0 b	0 c	0 c	29.0 ab
P-value	0.0262	0.0022	0.0231	0.0157

*Means followed by different letters within a column are statistically different using least significance difference at P≤0.05

Cumulative yields per plant from field trial



Bacterial endophyte study- *Bacillus velezensis*

Bacillus species are ubiquitous and of great economic importance

- Ability to colonize plants
- Produce spores, biofilms and antibiotics
- Induce synthesis of plant hormones

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The Institute of Advanced Learning and Research

Bacillus velezensis #619 had consistent increase of fruit yield compared with untreated control (15% increase in marketable yield and 17% in total yield in Aaron Creek Farm; 16% increase in marketable yield and 16% in total yield in Braehead Farm; and 8.8% increase in marketable yield and 14.3% increase in total yield in Greenbrier Farm).

We repeated the field trials in 2019 in 4 sites focusing on #619 with one and two applications. Yield data will be collected during 2020 harvest season.

Project title. Agronomic, Post-harvest, and Economic Evaluation of Strawberry Cultivars in High Tunnel and Open Field Production

Short-day	
101	Rocco
102	Camino Real
103	Chandler
104	Keepsake
105	R. June
106	Merced
107	Flavorfest
Day-neutral	
108	S. Andreas
109	S. Ann
110	Albion

Berries transplanted on 4 Oct., 2020

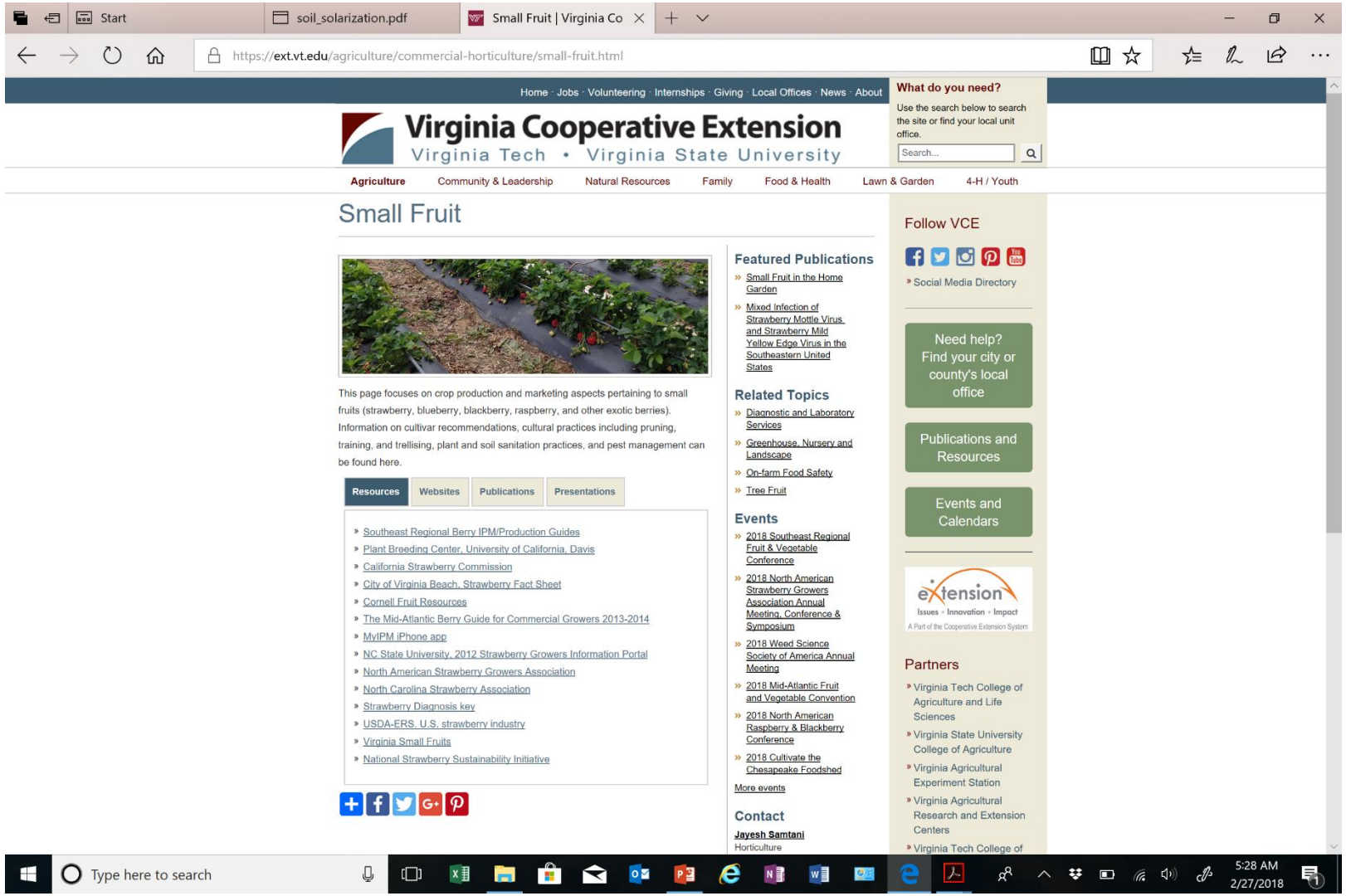
Feb 6., 2020

Rocco

Mar 2., 2020

Merced

https://ext.vt.edu/small-fruit.html



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