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Fungicides against Sunflower *Phomopsis*

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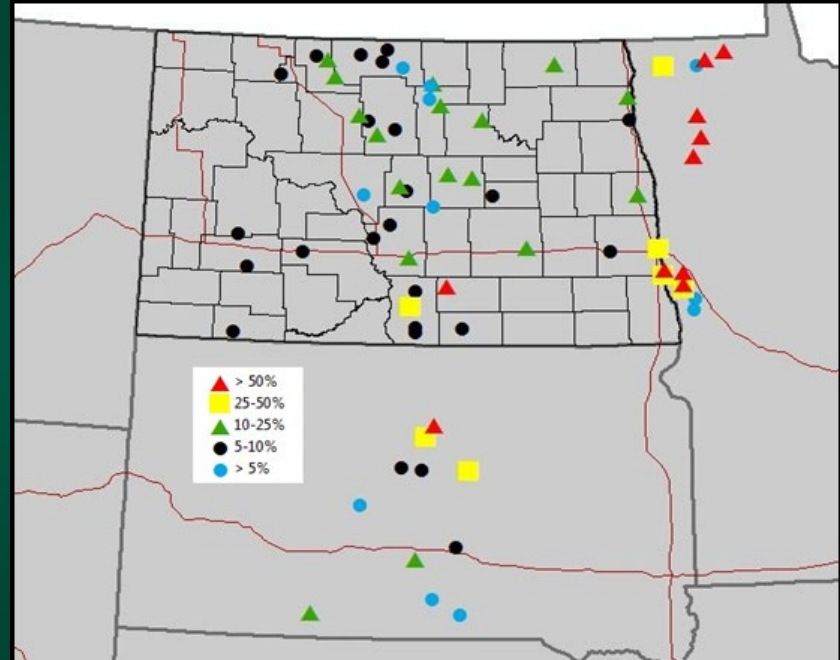
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Phomopsis stem canker

- First reported in the U.S. in 1980s (Herr et al. 1983)
- Disease epidemic in 2010 (Mathew et al. 2015)
- Multiple species of *Diaporthe* identified



National Sunflower Association Survey, 2010



Fungicides as an option?

- With funding from the NSA and (previously) SDOC and USDA-CARE, we evaluated foliar fungicides against *Phomopsis*
 - Fungicide application timings
 - Fungicide active ingredients

Fungicides as an option?

- Field trials conducted in MN, ND, NE and SD between 2009 and 2020 for a total of 79 location-years.
 - Randomized complete block design, at least 3 replicate blocks
 - 30 ft long, 10 ft wide, 30-inch row spacing, 4 rows
 - Confection – susceptible, partially-resistant
 - Oilseed – susceptible, partially-resistant
 - 18,000 to 22,000 seeds / A
 - Natural disease pressure

Fungicides as an option?

- Field trials conducted in MN, ND, NE and SD between 2009 and 2020 for a total of 79 location-years.
 - QoI (FRAC 11), Triazole / DMI (FRAC 3) and SDHI (FRAC 7)
 - Number of fungicide treatments varied;
 - NTC was included
 - Ground application



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Fungicides as an option?

- Field trials conducted in MN, ND, NE and SD between 2009 and 2020 for a total of 79 location-years.
 - QoI (FRAC 11), Triazole / DMI (FRAC 3) and SDHI (FRAC 7)
 - NTC was included
 - Ground application @ R1

Growth Stages: V5, R1 and R5



Fungicides as an option?

- Field trials conducted in MN, ND, NE and SD between 2009 and 2020 for a total of 79 location-years.
 - QoI (FRAC 11), Triazole / DMI (FRAC 3) and SDHI (FRAC 7)
 - NTC was included
 - Ground application @ R1
 - Disease severity evaluated after flowering
 - Yield

Fungicides against *Phomopsis*

- Application timing using DSI

Timing	k	Hedges' g	95% CI
V8	6	-0.11	[-0.62; 0.40]
R1	51	-0.57	[-0.82; -0.32]*
R5	16	-0.05	[-0.37; 0.27]
V8 + R1	7	-0.38	[-1.04; 0.29]
V8 + R5	6	-0.05	[-0.48; 0.57]
R1 + R5	19	-0.43	[-0.83; -0.02]*
V8 + R1 + R5	6	-0.31	[-0.98; 0.36]

Fungicides against *Phomopsis*

- Application timing using yield

Timing	k	Hedges' g	95% CI
V8	7	0.11	[-0.46; 0.68]
R1	55	0.33	[0.16; 0.50]*
R5	22	0.12	[-0.37; 0.13]
V8 + R1	7	0.20	[-0.28; 0.68]
V8 + R5	6	0.11	[-0.40; 0.63]
R1 + R5	23	0.23	[-0.01; -0.48]
V8 + R1 + R5	6	0.18	[-0.46; 0.81]

Fungicides against *Phomopsis*

- Active ingredients using DSI

Active Ingredient	FRAC group	k	Hedges' g	95% CI
Azoxystrobin	11	15	-0.60	[-1.09; -0.11]*
Boscalid	7	10	-0.21	[-0.73; 0.31]
Fluxapyroxad + Pyraclostrobin	7 + 11	16	-0.55	[-1.09; -0.00]*
Mefentrifluconazole	3	2	-1.20	[-2.40; -0.02]*
Mefentrifluconazole + Pyraclostrobin	3 + 11	4	-1.51	[-3.19; 0.89]
Mefentrifluconazole + Pyraclostrobin + Fluxapyroxad	3 + 11 + 7	2	-2.23	[-4.03; -0.44]*
Picoxystrobin	11	14	-0.58	[-1.38; 0.22]
Pyraclostrobin	11	46	-0.65	[-0.95; -0.36]*
Tebuconazole	3	10	-0.51	[-1.30; 0.28]

Fungicides against *Phomopsis*

- Active ingredients using yield

Active Ingredient	FRAC group	k	Hedges' g	95% CI
Azoxystrobin	11	15	0.19	[-0.28; 0.66]
Boscalid	7	10	-0.23	[-0.62; 0.17]
Fluxapyroxad + Pyraclostrobin	7 + 11	16	0.36	[0.05; 0.67]*
Mefentrifluconazole	3	2	-0.07	[-0.86; 0.72]
Mefentrifluconazole + Pyraclostrobin	3 + 11	4	1.04	[-0.05; 2.14]
Mefentrifluconazole + Pyraclostrobin + Fluxapyroxad	3 + 11 + 7	2	0.85	[0.03; 1.68]*
Picoxystrobin	11	14	0.65	[-0.14; 1.44]
Pyraclostrobin	11	46	0.43	[0.22; 0.64]*
Tebuconazole	3	10	0.26	[-0.12; 0.63]



Headline @ R1

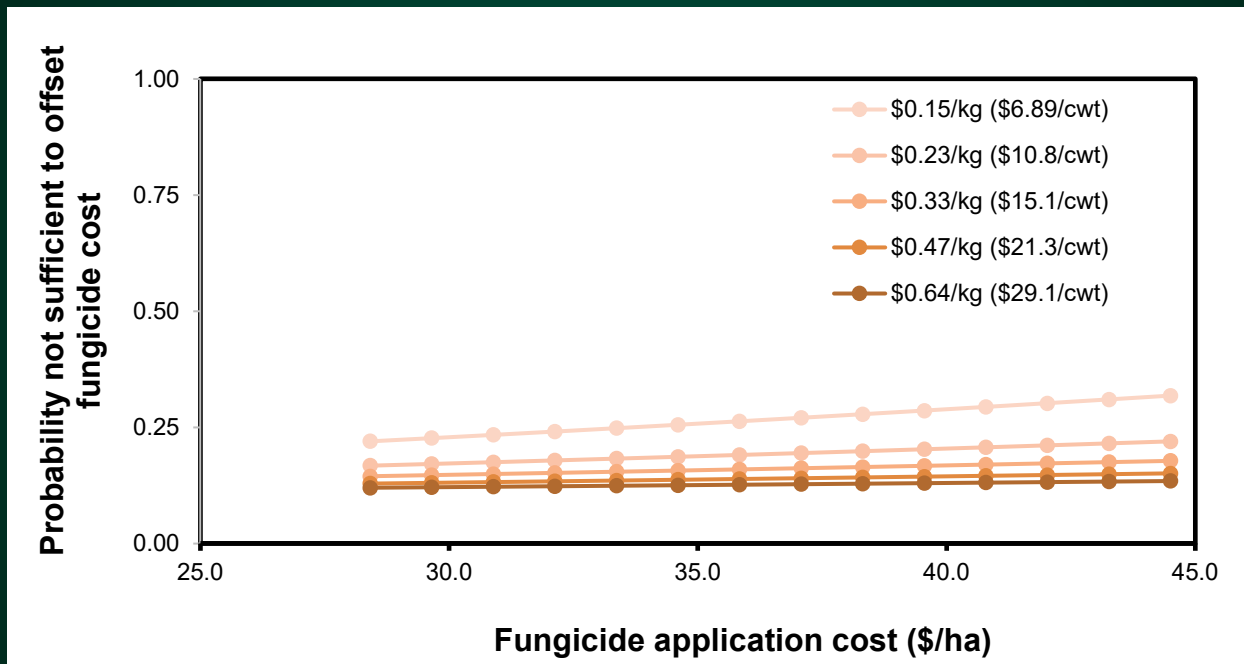


Nontreated control

Fungicides as an option?

- Between 2000 and 2020, sunflower grain prices ranged from \$6.89/cwt to \$29.1/cwt.
- Net return calculated based on average local prices from SD retailers for Headline (\$6/A)
- Estimated fungicide application cost = ground (\$5.5 to 8/A) and aerial (\$9 to 12/A)

Fungicides against *Phomopsis*



Fungicides as an option?

- Foliar fungicides containing pyraclostrobin are effective against *Phomopsis* when applied at R1 growth stage.
- However,

QoI Resistance in *Phomopsis*

Karthika Mohan, Febina Mathew & Samuel Markell, NDSU, Dept. of Plant Pathology, Fargo, ND;
Robert Harveson, University of Nebraska-Lincoln, Panhandle Res. & Ext. Center, Scottsbluff, NE;
Megan M. McCaghey, U of M, Dept. of Plant Pathology, St. Paul, MN

Research objective:

To evaluate fungicide effectiveness and application timing for management of Phomopsis stem canker under field conditions in MN, ND, NE and SD

Field study

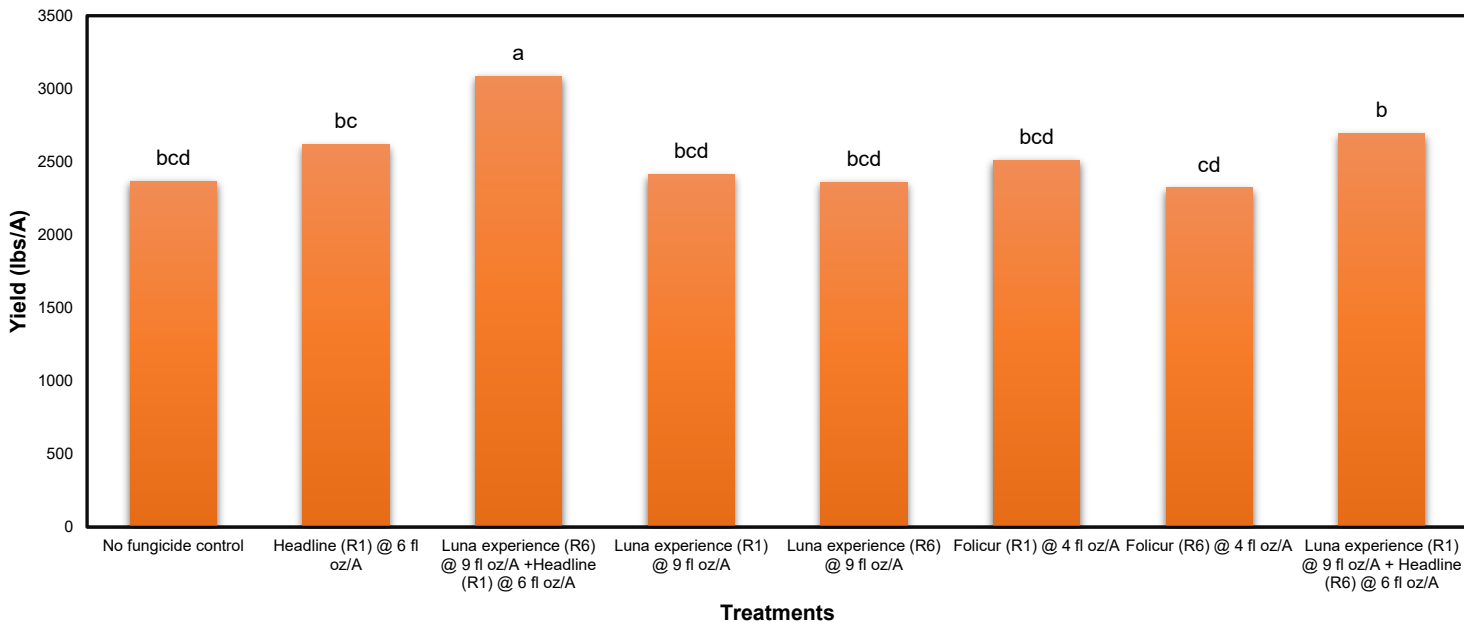
- Susceptible hybrid (Nuseed Genetics) in MN, ND, NE and SD
- Fungicides sprayed with adjuvants [NIS (0.25% V/V, Induce) and Crop oil (0.08% V/V, Interlock)] with backpack or hi-boy sprayer [Water volume – 15 gal/A]
- Disease severity evaluated after flowering
- Yield

Field study

- Randomized complete block with 10 treatments and 4 replicate blocks
 - No fungicide control
 - Headline (R1) @ 6 fl oz/A
 - Luna experience (V8) @ 9 fl oz/A
 - Luna experience (V8) @ 9 fl oz/A + Headline (R1) @ 6 fl oz/A
 - Luna experience (R6) @ 9 fl oz/A + Headline (R1) @ 6 fl oz/A
 - Luna experience (R1) @ 9 fl oz/A
 - Luna experience (R6) @ 9 fl oz/A
 - Folicur (V8) @ 4 fl oz/A
 - Folicur (R6) @ 4 fl oz/A
 - Luna experience (R1) @ 9 fl oz/A + Headline (R6) @ 6 fl oz/A]

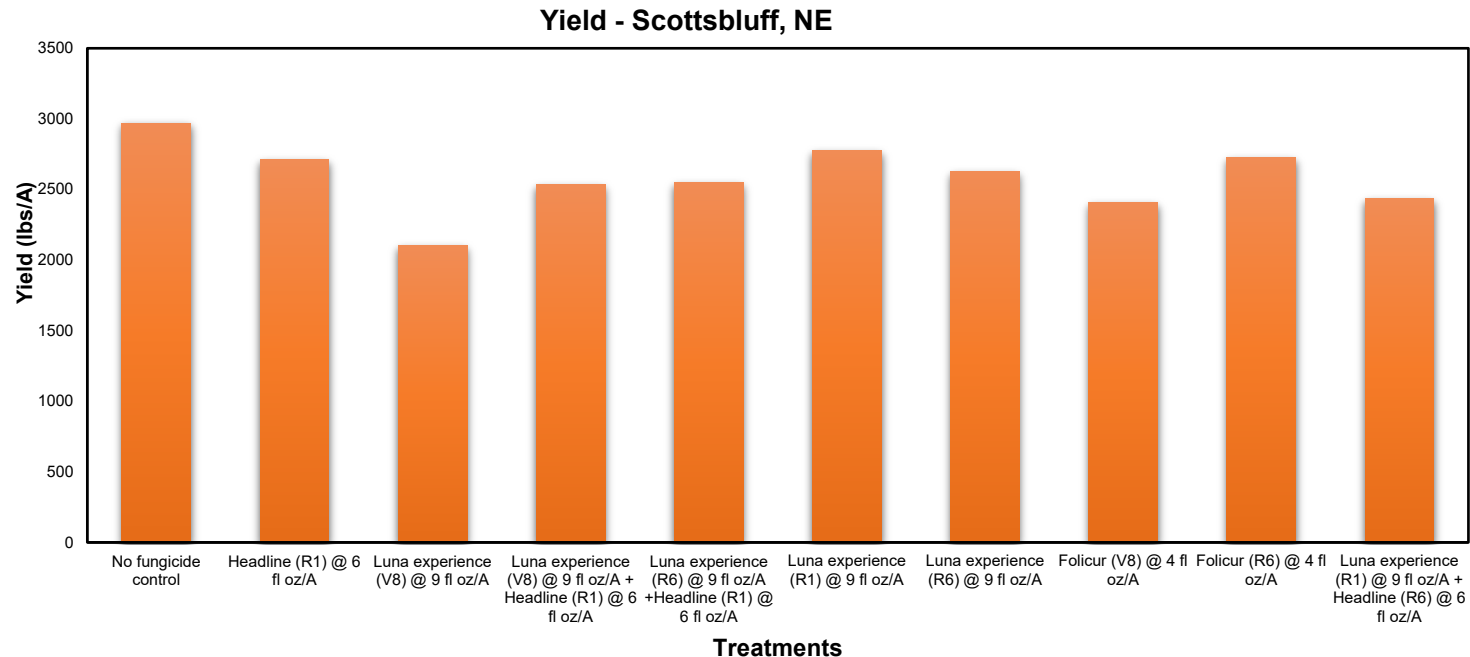
Field study

- In Brookings, SD, one application of Headline at R1 followed by a single application of Luna experience at R6 showed 30% greater yield (significant at $P=0.0005$) when compared to NTC



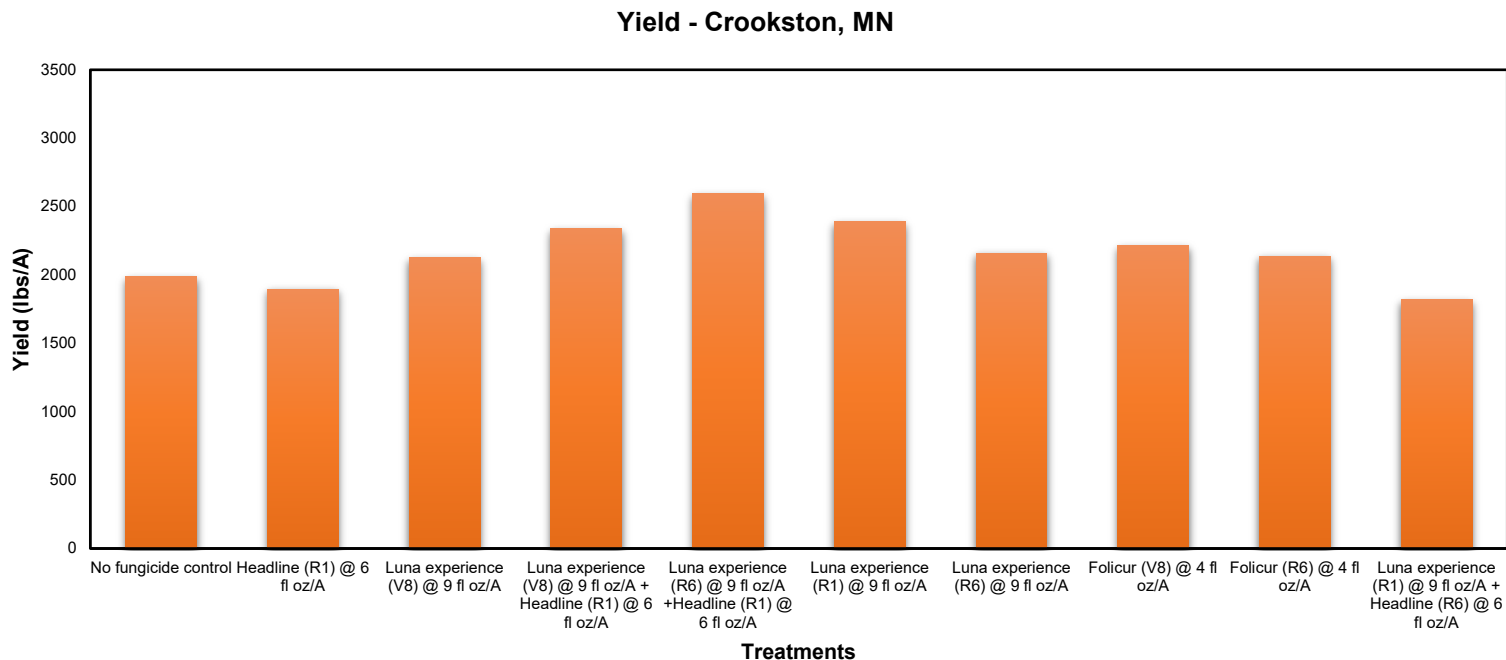
Field study

- In Crookston, MN, Grandin, ND and Scottsbluff, NE, significant differences in yield were not observed among treatments



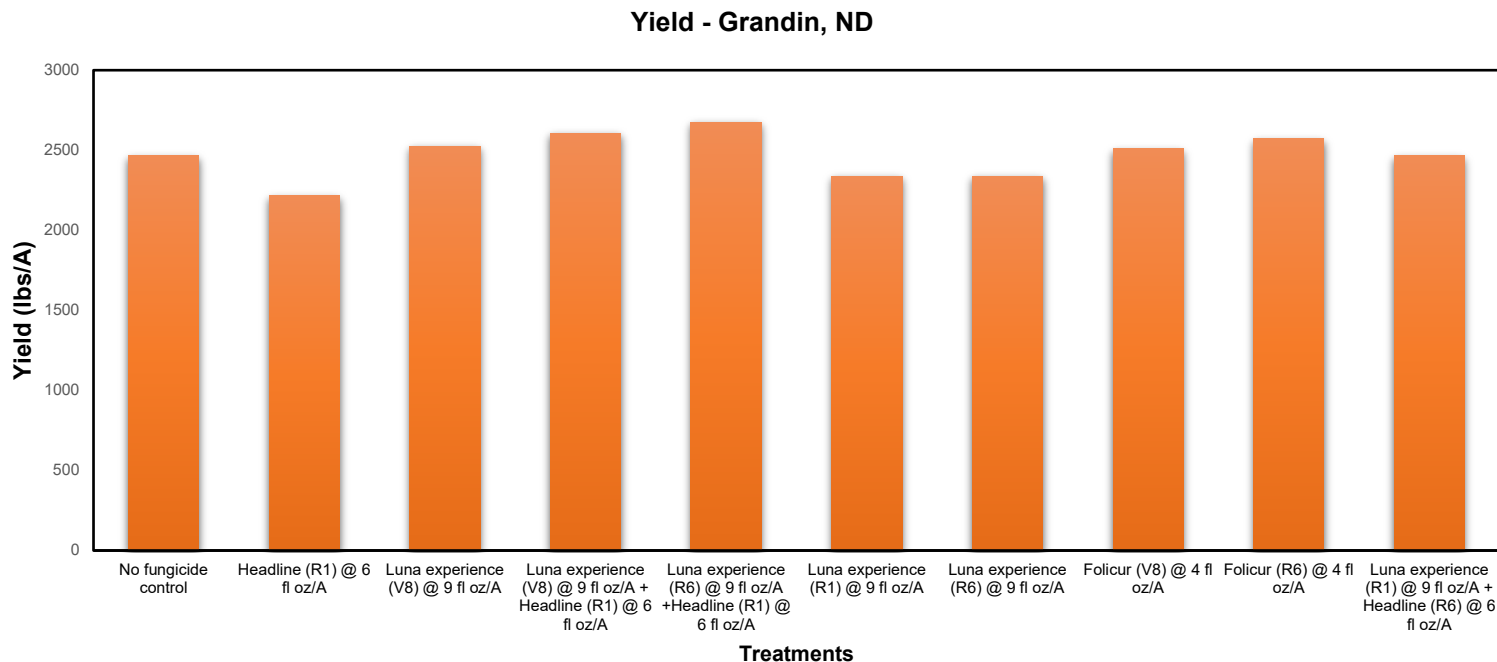
Field study

- In Crookston, MN, one application of Headline at R1 followed by a single application of Luna experience at R6 showed 23% greater yield, when compared to NTC.



Field study

- In Grandin, ND, one application of Headline at R1 followed by a single application of Luna experience at R6 showed 8% greater yield, when compared to NTC.



Summary

- One application of Headline at R1 followed by a single application of Luna experience at R6 showed 8 to 30% greater yield when compared to no-fungicide control.
- The study will be repeated in 2023 in MN, ND, NE and SD.

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