AGRICULTURAL RESEARCH FOUNDATION
PRELIMINARY (First-Year) REPORT
FUNDING CYCLE 2019 – 2021

TITLE: Recommendations for the Micronutrient Section of Oregon State University Dryland (Winter Wheat) Fertilizer Guides

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EXECUTIVE SUMMARY: The first year of this two-year experiment was successful. Treatments "went on" as intended, and growing conditions were good. There was little or no pest pressure. Harvest operations occurred without difficulty. There was some evidence of enhanced, treatment-induced nutrient uptake. There was a strong, statistical trend of improved yield from the application of boron. Readers of this interim report are encouraged to withhold judgement about treatment effects until after publication of the final report in December of 2021 or January of 2022.

OBJECTIVE: To develop or refine recommendations for zinc and boron fertilization of dryland winter wheat.

PROCEDURES: Two field trials (one in Morrow County and another at the Sherman Station) were conducted in fields representative of those found in a 350,000 acre region east of Oregon's Cascade Mountain Range. Selected chemical properties of soil, at both locations, are provided **Table 1**.

Treatments included application of zinc as a seed treatment and application of zinc or boron as a coating on a dry formulation of ammonium phosphate-sulfur (**Table 2**). Ammonium phosphate sulfur (16-20-0-12) was applied "with-the-seed." Plots were "arranged" in a randomized and replicated block design. Seeding occurred in mid-to-late September.

Table 1. Chemical properties of surface-foot soil at trial locations in dryland winter wheat fields of eastern Oregon.

Trial Location (Soil Type)	**Soil pH**	**Soil Organic Matter Content**	**--------Concentration in Soil--------**	
			Zinc	**Boron**
<u>2019-2020</u>		(%)	(ppm)	(ppm)
Morrow County (Ritzville)	6.7	1.1	0.5	0.5
Sherman Station (Walla Walla)	5.6	1.8	0.8	0.3

Soil sampling was conducted one month before seeding. Plant samples were collected when wheat was in the "late tillering" stage of growth (just before "jointing"). Soil and plant samples were tested by personnel at an NAPT-PAP accredited laboratory in Kennewick, Washington. The yield, test weight, and protein content of harvested grain was determined using standardized methodology.

Table 2. Treatment descriptions, abbreviations and corresponding application rates.

Treatment Number	Treatment Description and (Abbreviation)	Rate of Application†
1	No Zinc Seed Start (**Control**)	0
2	4 oz/cwt Zinc Seed Start (**4 oz Zn SS**)	0.1
3	8 oz/cwt Zinc Seed Start (**8 oz Zn SS**)	0.2
4	APS Starter; 16-20-0-12; Dry Fertilizer; (**APS Control**)	0
5	APS Starter + Zinc Coating (**APS + Zn**)	1.0
6	APS Starter + Boron Coating (**APS + B**)	0.5

† *Pounds of actual zinc or boron/acre*

SIGNIFICANT ACCOMPLISHMENTS: Treatment had no or little effect on early-season growth and development (dry matter) of winter wheat (**Tables 3, 5, and 7**). It was interesting to note, however, that the Morrow County application of zinc, as a coating on a dry formulation of ammonium phosphate-sulfate (APS; 16-20-0-12), was the only treatment that produced a quantity of biomass greater than the overall mean.

Table 3. Effect of zinc seed start (Zn SS) on early-season dry matter, tissue zinc concentration, and zinc uptake in winter wheat.

Treatment (by Location)	Early-Season Dry Matter	Tissue Zinc Concentration	Zinc Uptake
Morrow County	lb/acre	ppm	lb zinc/acre
Control	2,538	9.8	0.03
4 oz Zn SS	2,526	10.1	0.03
8 oz Zn SS	2,509	11.4	0.03
Sherman Station			
Control	2,381	16.2	0.04
4 oz Zn SS	2,443	20.3	0.05
8 oz Zn SS	2,423	20.5	0.05

Table 4. Effect of zinc seed start (Zn SS) on the yield, test weight, and protein content of harvested grain.

Treatment (by Location)	Grain Yield	Grain Test Weight	Grain Protein Content
Morrow County	bu/acre	lb/bu	%
Control	67.6	62.1	10.6
4 oz Zn SS	67.5	61.5	10.6
8 oz Zn SS	63.2	62.1	11.0
Sherman Station			
Control	81.1	62.9	10.2
4 oz Zn SS	80.6	62.5	10.3
8 oz Zn SS	80.0	62.3	10.4

Table 5. Effect of zinc (applied as a coating on a dry formulation of ammonium phosphate-sulfate; 16-20-0-12) on early-season dry matter, tissue zinc concentration, and zinc uptake in winter wheat.

Treatment (by Location)	Early-Season Dry Matter	Tissue Zinc Concentration	Zinc Uptake
Morrow County	lb/acre	ppm	lb zinc/acre
APS Control	2,538	10.1	0.03
+ Zn	2,715	14.1	0.04
Sherman Station			
APS Control	2,381	13.8	0.03
+ Zn	2,431	20.2	0.05

Zinc application increased the nutrient concentration in plant tissue (**Tables 3 and 5**). A relatively weak response occurred in Morrow County plots where planted seed was treated with 4 or 8 oz/cwt of zinc seed start. There was a trend, at the same site, of reduced grain yield from the 8 oz/cwt treatment. It will be interesting to learn if this trend "holds true" in next year's Morrow County trial.

Table 6. Effect of zinc (applied as a coating on a dry formulation of ammonium phosphate-sulfate; 16-20-0-12) on the yield, test weight, and protein content of harvested grain.

Treatment (by Location)	Grain Yield	Grain Test Weight	Grain Protein Content
Morrow County	bu/acre	lb/bu	%
APS Control	68.6	62.1	10.6
+ Zn	68.8	61.8	10.8
Sherman Station			
APS Control	81.1	62.9	10.4
+ Zn	82.2	62.7	10.1

Table 7. Effect of boron (applied as a coating on a dry formulation of ammonium phosphate-sulfate; 16-20-0-12) on early-season dry matter, tissue boron concentration, and boron uptake in winter wheat.

Treatment (by Location)	Early-Season Dry Matter	Tissue Boron Concentration	Boron Uptake
Morrow County	lb/acre	ppm	lb boron/acre
APS Control	2,538	4.8	0.012
+ B	2,542	6.5	0.017
Sherman Station			
APS Control	2,381	2.7	0.006
+ B	2,447	4.2	0.010

Zinc uptake was mostly unaffected by treatment. An exception occurred in the higher yielding environment at the Sherman Station. At this location, the application of zinc, as a coating on a dry formulation of ammonium phosphate-sulfate (APS; 16-20-0-12), increased the average uptake value by 0.02 lb zinc/acre. This statistically significant outcome is somewhat surprising, because initial soil test zinc levels were relatively high (**Table 1**).

There was a strong trend ($P \approx 0.1$) of improved boron uptake and grain yield at both trials, but the effect (**Tables 7 and 8**) was most evident at the Sherman Station—a site with a lower initial, soil test boron level (0.5 ppm). Treatments had no effect on the test weight and protein content of harvested grain.

Table 8. Effect of boron (applied as a coating on a dry formulation of ammonium phosphate-sulfate; 16-20-0) on the yield, test weight, and protein content of harvested grain.

Treatment (by Location)	Grain Yield	Grain Test Weight	Grain Protein Content
Morrow County	bu/acre	lb/bu	%
APS Control	68.6	62.1	10.6
+ B	69.9	62.3	10.6
Sherman Station			
APS Control	81.1	62.9	10.4
+ B	86.9	62.7	10.0

BENEFITS & IMPACT: The benefit and impact of this research will be clearly delineated after completion of the second-year of research (December of 2021 or January of 2022).

ADDITIONAL FUNDING RECEIVED DURING PROJECT TERM: Additional funding of $6,624 was awarded by the Oregon Wheat Commission.

FUTURE FUNDING POSSIBILITIES: Future funding opportunities for this kind of work are limited. Additional funding, if any, will be used to conduct follow-up trials that deal with micronutrient nutrition of wheat plants and/or biofortification of flour. [END; LKL].