

Proline Metabolite Increases Grain Yield with Foliar, In-Furrow, and Side-Dress Applications

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Background

Plants evolved in nitrogen limited environments and developed sophisticated systems around nutrient budgeting for ensured survival and reproduction. Work at Los Alamos National Laboratories led to the discovery of the gatekeeping molecule monitoring and managing the system used by plants to regulate nitrogen and carbon fixation (Knight and Langston-Unkefer, 1988, Unkefer et al., 2000). Verdesian Life Sciences has licensed the discovery as Take Off[®] Technology, currently commercialized in seed treatments and foliar capacities with Take Off ST[®], Preside CL[®], Take Off Sulfone[®], Primacy Alpha[®], and Symbol Advance[®].

The proline metabolite 2-oxoglutaramate signals an influx of nitrogen and induces carbon fixation via glutamine synthetase pathway while maintaining elemental stoichiometry. This process reciprocates during the uptake of nitrogen, synthesizing key end products which create measureable increases in photosynthesis, carbon fixation, and nitrogen utilization.

Research trials in row crop systems with *Zea mays* in 2015 set out to discover how the manipulation of nitrogen utilization impacts grain yield when used in conjunction with typical applications on-seed, in-furrow, foliar, and side dressed nutrients.

Protocol and Site Selection

Sites were selected based on typical crop rotations and planted with the highest potential yielding genetics at the researcher's discretion with fungicide/insecticide seed treatments. Tillage was minimal and plots used a randomized complete block (RCB) with a plot size of at least 37m² (400 ft²) and a minimum of 4-replications and assessed for grain yield. The technology was deployed as described at varying rates of active ingredient (A.I.) of the functional analogue of 2-oxoglutaramate (2-O Analogue) in grams per hectare.

On-Seed: Seed treatments were applied in a slurry with a minimum application of 4 L/t with a rate of Take Off ST[®] (2-O ST) at a rate of 0.6-2.4 mL per kg of seed (12 oz. - 48 oz. per ton) on *Zea mays*.

In-furrow: Starter fertilizer applied as 6-24-6 at a rate of 46.8 L/ha (5 gallons per acre) in-furrow, on the seed bed before the seed is placed. Take Off[®] was mixed with the starter fertilizer for an application of 124 - 248 g/ha (3.4 - 6.8 oz. per acre).

Foliar: Applications were made at V-6 - V-8 with *Zea mays* with a minimum of 93.5 L/ha carrier as water alone, or with 18.7 L/ha (2 gallons per acre) SRN25B, a slow release nitrogen product with 0.5% boron by weight.

Side Dress: Urea ammonium nitrate (UAN) solution was applied at a rate of 468 L/ha (50 gallons per acre) of UAN on corn between the rows on the surface at V-6 - V-8. Take Off[®] was mixed with the uan at rates of 62, 124, 248 g/ha (1.7, 3.4, 6.8 oz. per acre) on *Zea mays*.

Field Results

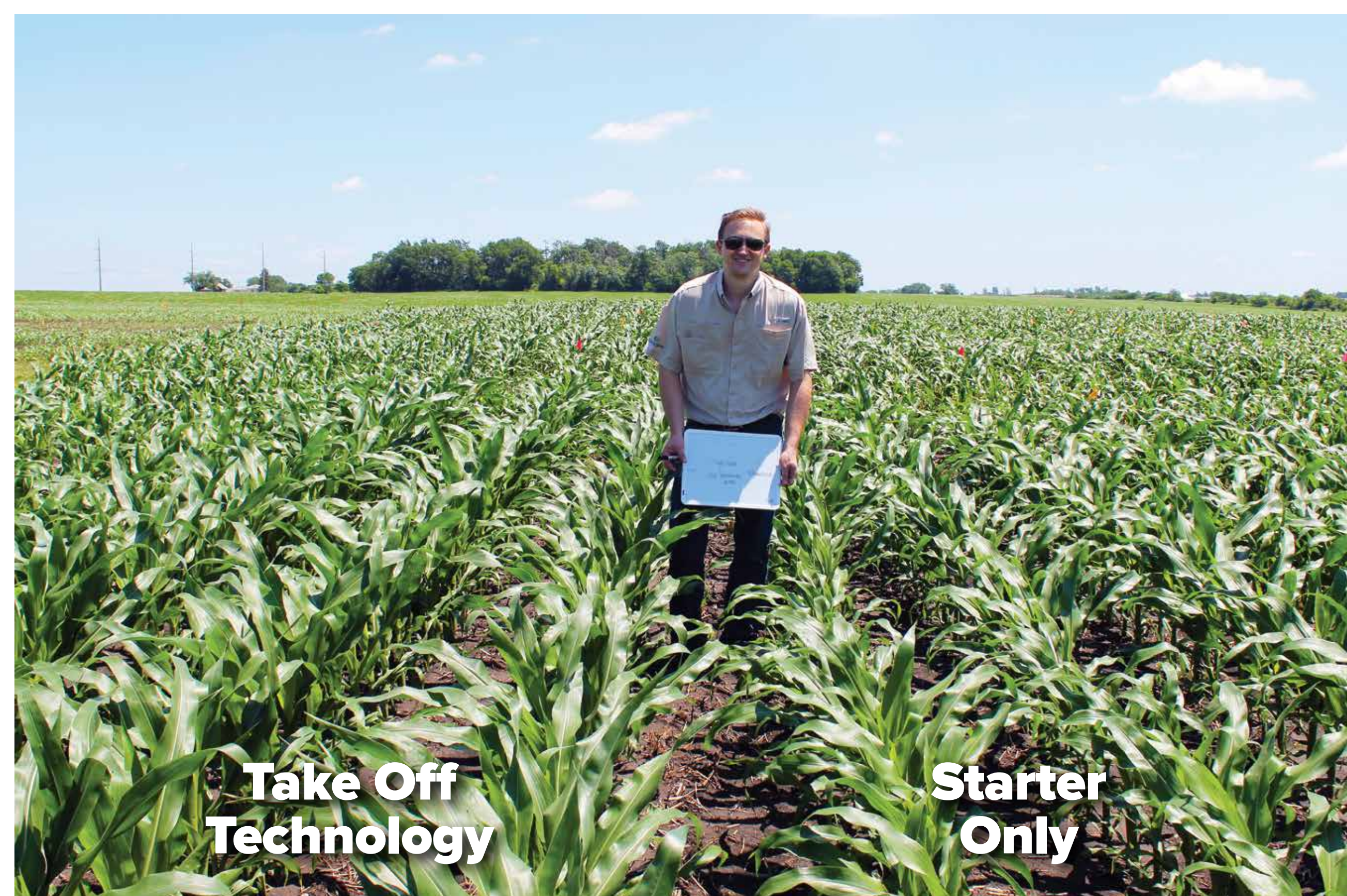


Figure 1. In-furrow treatments in Cedar Falls, IA. On the left, the in-furrow treatment had Take Off[®] on 4 rows, while on the right the treatment was starter only in-furrow. Visual differences were observed at V-4 through V-8 which were substantiated by yield results.

Field data with the functional analogue of 2-oxoglutaramate (2-O Analogue)

UAN Side Dress at V-6 to V-8 on *Zea mays*

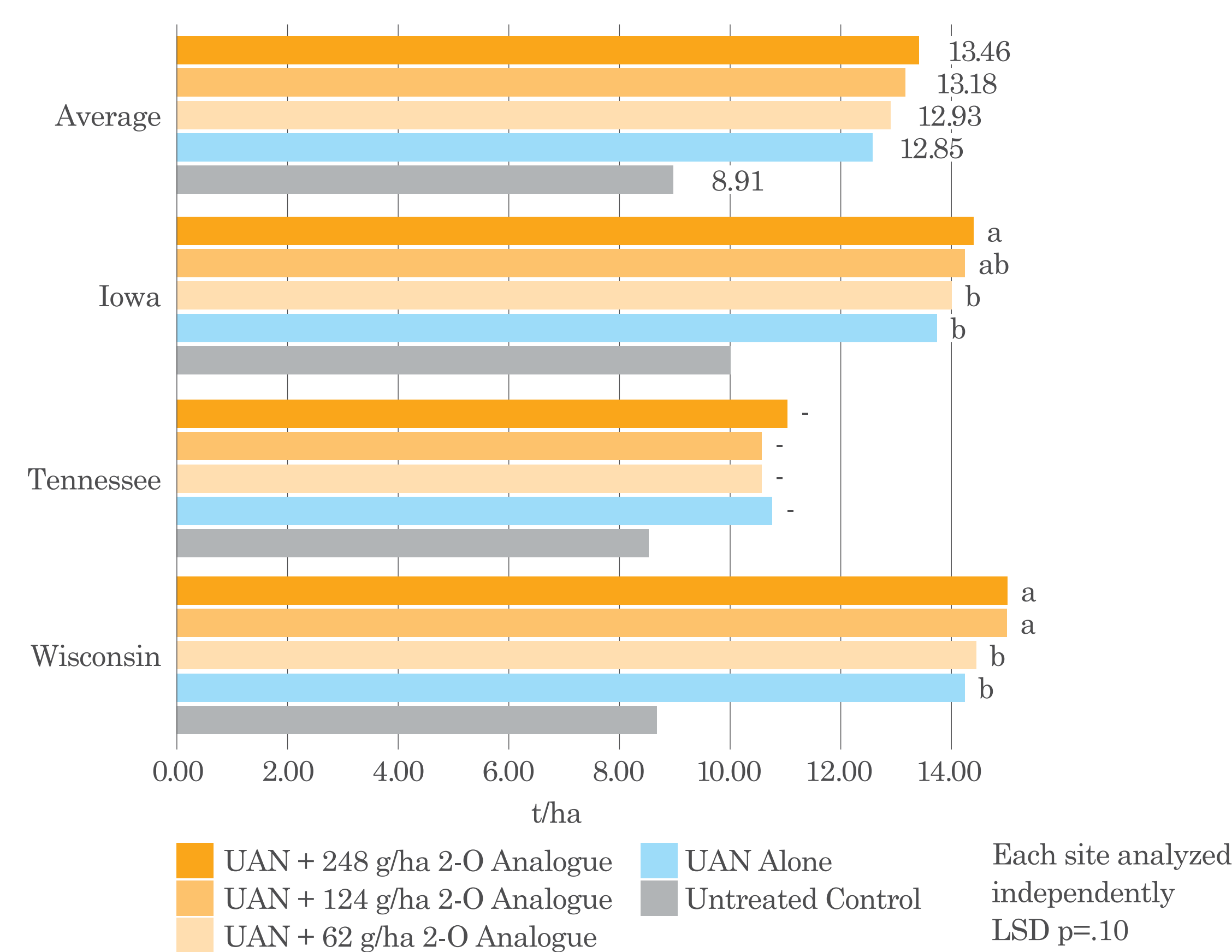


Figure 2. The high rate of 248 g/ha provided an additional 0.61 t/ha (9.7 bu/a) of yield over the control on three N-responsive sites.

On-Seed Applications of 2-O Analogue on *Zea mays*

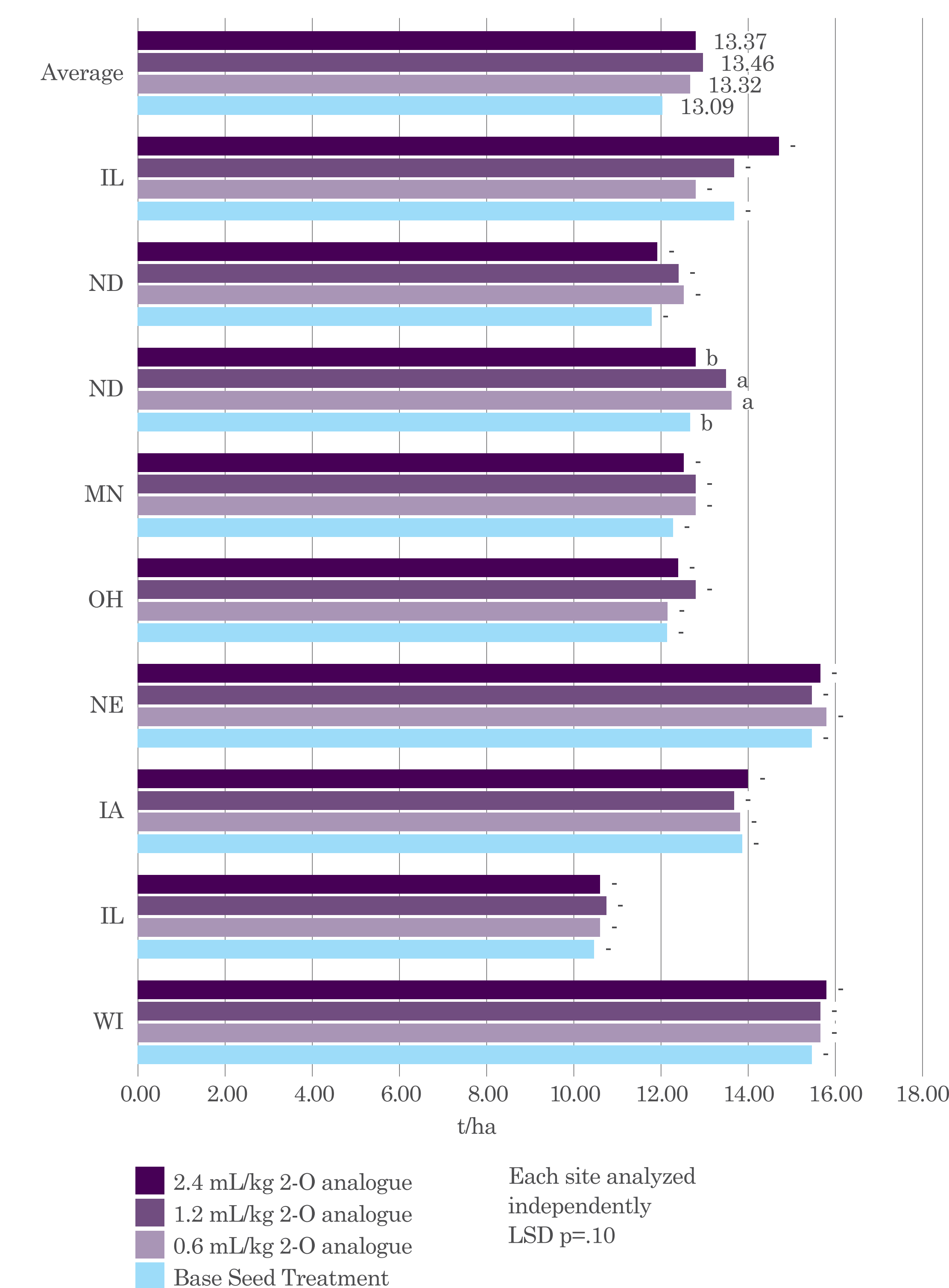


Figure 4. On-seed applications of 2-O Analogue increased yield by 0.23, 0.37, and 0.28 t/ha (3.7, 5.9, 4.5 bu/a) respective of titrated rates low to high over 9 locations.

Conclusion

Applications on-seed, in-furrow, as a foliar, and on side-dress UAN provided positive yield responses with correct application rates and placement in replicated trials across the Midwest on *Zea mays*. Nitrogen management and efficiency is at the forefront of conversations when water quality and environmental issues arise in agriculture and any tool which lessens nitrogen's longevity in the soil should be looked at by farmers and researchers alike.

In-furrow Starter Fertilizer on *Zea mays*

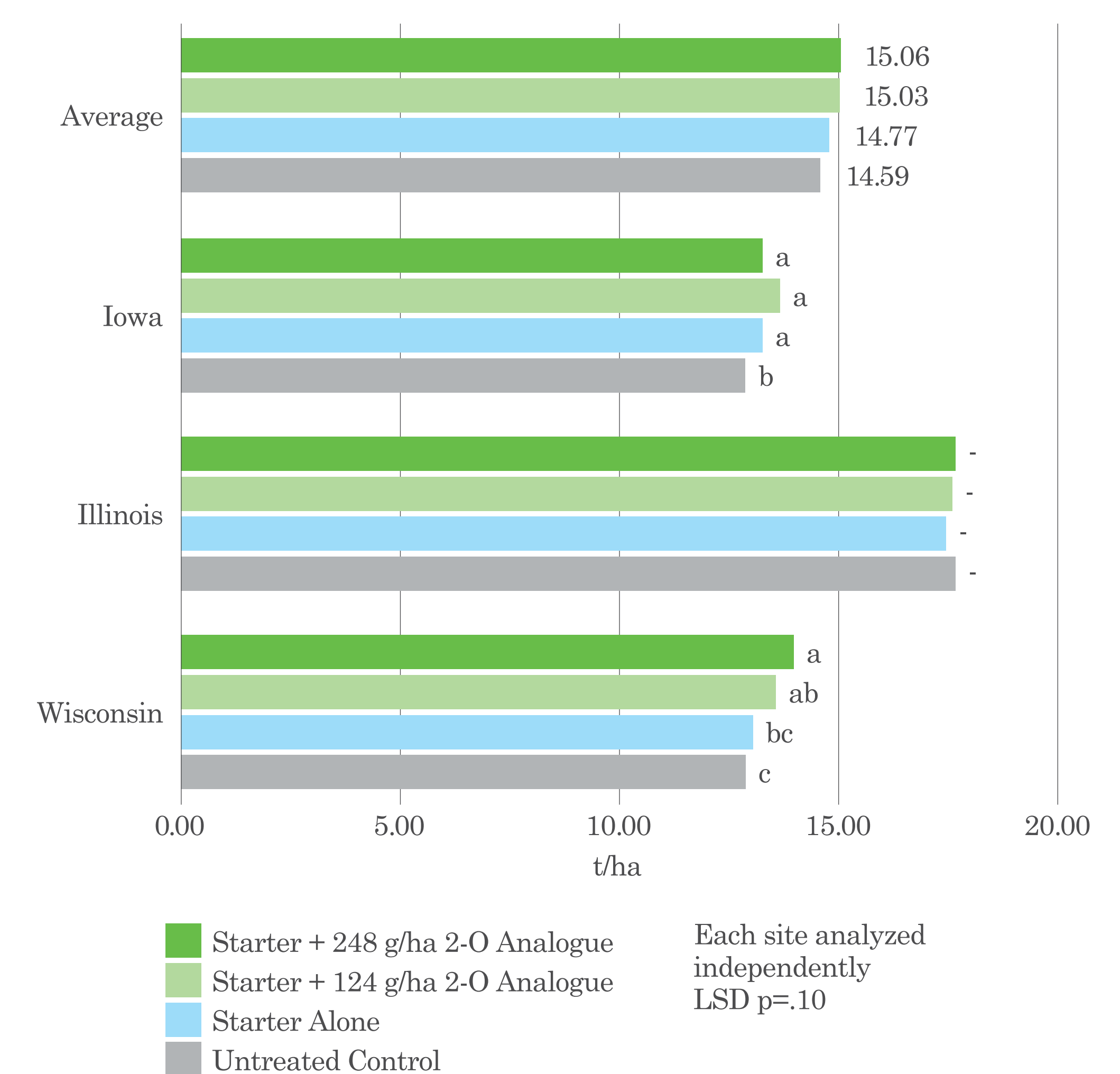


Figure 3. In-furrow starter application yielded a response in 2 of 3 sites; both rates of 2-O Analogue increased yield by 0.26 t/ha and 0.29 t/ha (4.1 and 4.6 bu/a).

Foliar Applications at V-6 to V-8 on *Zea mays*

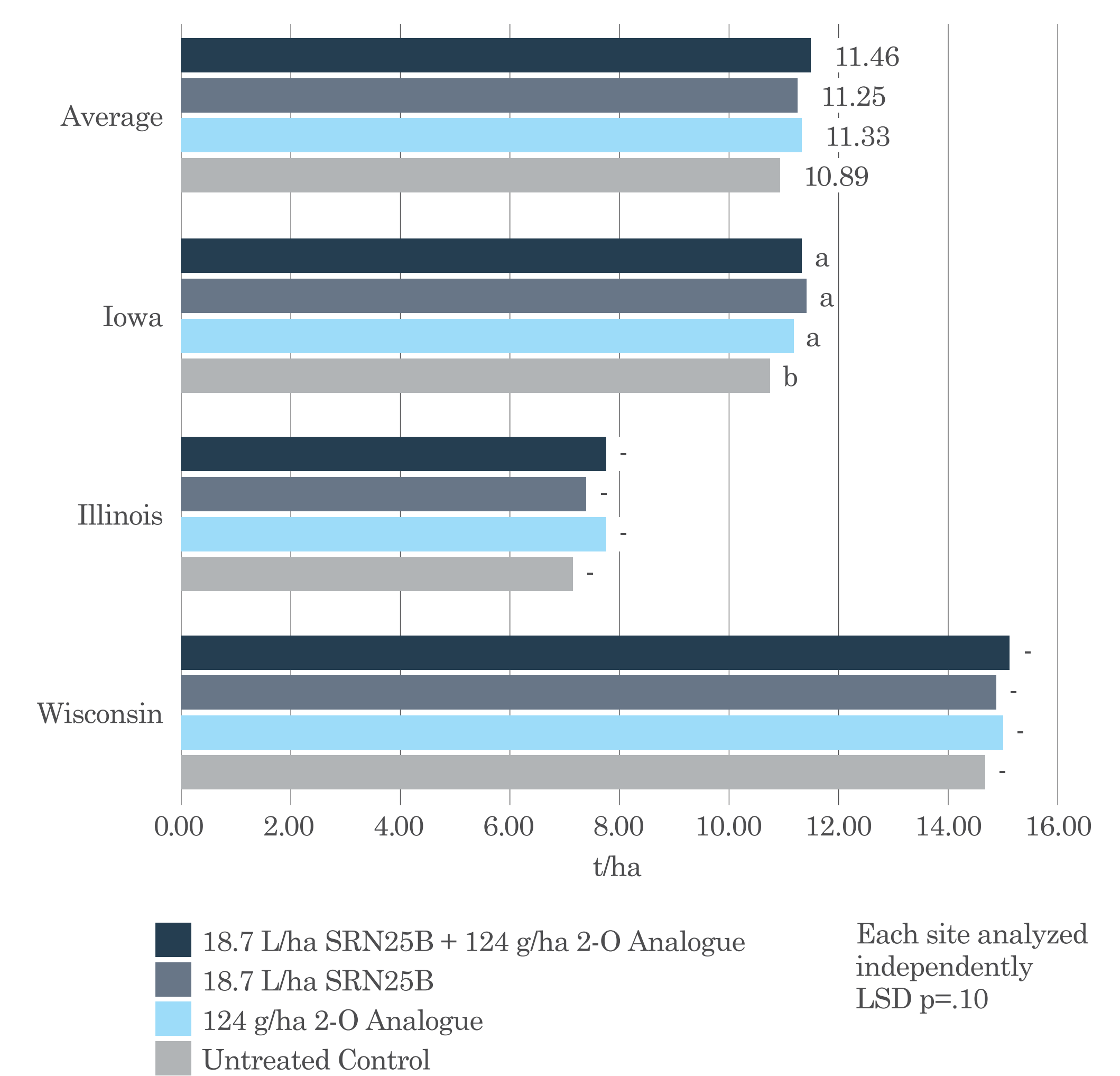


Figure 5. Foliar applications of 2-O Analogue alone yield 0.44 t/ha (7.0 bu/a) better than no foliar. Low rates of SRN25B with 2-O Analogue increased yield 0.21 t/ha (3.3 bu/a).

Acknowledgement

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References

Knight, T.J., and Langston-Unkefer, P.J. (1988). Science 241, 951-954.
Unkefer, P.J., T.K. Knight and R. Martinez. Use of prolines for improving growth and other properties of plants and algae. US Patent filed 1/27/00.