

OPTINYTE® TECHNOLOGY VS. DICYANDIAMIDE (DCD)

(Nitrapyrin)

**Optinyte®
technology**

N-Serve®
Instinct NXTGEN®
and Vindicare®
nitrogen stabilizers

Length of control

up to 8 weeks



Positive impact
on yield?

YES

Relative amount of
active ingredient
needed per acre

1x

YES

Positive
environmental
impact

Soil stability

stable



(Dicyandiamide)

DCD

1-2 weeks



Data
does not
support¹

up to

30x



Data
does not
support²



¹ **NutrienStar**, Dicyandiamide (DCD) <http://nutrienstar.org/food-finder/eed/>

² **Yang, M., Y. Fang, D. Sun, and Y. Shi. 2016.** Efficiency of two nitrification inhibitors (dicyandiamide and 3,4-dimethylpyrazole phosphate) on soil nitrogen transformations and plant productivity: a meta-analysis. www.nature.com/articles/srep22075.pdf



POSITIVE IMPACT ON YIELD

OPTINYTE® TECHNOLOGY (Nitrapyrin)
N-Serve®, Instinct NXTGEN® and Vindicate® nitrogen stabilizers

YES

The effect of nitrapyrin on grain yield consisted of 189 observations comprising 437 mean comparisons across 158 locations – years of experiments, with 141 of 189 observations showing a positive effect of nitrapyrin on yield. The grand mean represents a relative yield increase from nitrapyrin of 7.0% when used with fall nitrogen applications and of 5.2% when used with spring applications.

Fall-applied

7%

average yield
increase

Spring-applied

5.2%

average yield
increase

Source: Wolt, J. D. 2004.

A meta-evaluation of nitrapyrin agronomic and environmental effectiveness with emphasis on corn production in the Midwestern USA.
Nutr. Cycl. Agroecosyst. 69: 23–41. doi:10.1023/B:FFRES.0000025287.52565.99.

While holding fertilizer rate and other management characteristics constant, nitrapyrin treatment increases average grain yield for both corn and wheat in North America. These yield benefits suggest that nitrapyrin increases nitrogen use efficiency. Such action could reduce environmentally harmful nitrogen losses.

Given its demonstrated ability to increase crop yield, nitrapyrin promises to be an important component of improved management practices.

Source: NutrientStar

DCD (Dicyandiamide)

Data does not support¹

With the data available, and in the conditions studied, DCD did not have any beneficial yield impacts for either wheat or corn.¹ Some of the studies reporting yield decline may not have fully considered the potential for phytotoxicity with certain application methods. Therefore, if DCD is to be recommended as a product for improving N use efficiency, more research (or increased accessibility of existing field data) is needed to determine the climate and soil characteristics or other management practices most likely to see such benefits.

Source: NutrientStar

“DCD did not have any beneficial yield impacts for either wheat or corn.”

Source: NutrientStar | www.nutrientstar.org

NutrientStar is a science-based review program for nutrient management. A nutrient management tool or product earns a spot on the NutrientStar website when its independent



review panel assesses available data on the product's ability to increase nutrient use efficiency during field trials. They use a scientifically rigorous, transparent method for measuring efficiency that allows the review panel to assess tools by their level of performance.

¹ NutrientStar, Dicyandiamide (DCD). <http://nutrientstar.org/tool-finder/dcd/>



RELATIVE AMOUNT OF ACTIVE INGREDIENT NEEDED PER ACRE

OPTINYTE® TECHNOLOGY (Nitrapyrin)
N-Serve®, Instinct NXTGEN® and Vindicate® nitrogen stabilizers

1x

“Nitrapyrin is quite effective even at relatively low rates.”

DCD (Dicyandiamide)

up to
30x

“Dicyandiamide is required at a significantly larger concentration to be effective.”

Dicyandiamide is required at a significantly larger concentration to be effective. Zacherl and Amberger (1990) found that DCD had to be applied at concentrations of 300 ppm to inhibit the activity of Nitrosomonas. Nitrapyrin is quite effective even at relatively low rates. Rates as low as 0.1 ppm have been shown to effectively inhibit certain strains of Nitrosomonas, but rates of 10 ppm has been shown to be effective against most strains (Beiser and Schmidt, 1981).

Source: Robert Mullen | Nitrogen additives: What is what, and do they work?

“DCD is effective only at certain rates; however, the rates used typically are not high enough to be effective.”

Source: North Dakota State University | Dave Franzen

Mullen, Robert W. 2010. Nitrogen additives: What is what, and do they work? Proceedings of the Integrated Crop Management Conference. 23. <https://lib.dr.iastate.edu/icm/2010/proceedings/23>

Franzen, D. 2017. Chemistry to Enhance Nitrogen and Phosphorus Efficiency. Indiana CCA Conference, 12 December, 2017, North Dakota State University.



POSTIVE ENVIRONMENTAL IMPACT

OPTINYTE® TECHNOLOGY (Nitrapyrin)
N-Serve®, Instinct NXTGEN® and Vindicate® nitrogen stabilizers

YES

Optinyte technology in Instinct NXTGEN and N-Serve nitrogen stabilizers was awarded the Presidential Green Chemistry Challenge Award stating that the technology added about 50 million bushels of additional corn equating to over \$205 million in additional production revenue for U.S. corn growers; and reduced carbon dioxide emissions by about 664,000 metric tons.

Source:
Environmental
Protection Agency



Results showed that on average, greenhouse gas emissions decreased by 51 percent.

51% less greenhouse gas emissions

Source: Wolt, J. D. 2004.
A meta-evaluation of nitrapyrin agronomic and environmental effectiveness with emphasis on corn production in the Midwestern USA.
Nutr. Cycl. Agroecosyst. 69: 23–41. doi:10.1023B:FRES.00000025287.52565.99.

Environmental Protection Agency. Presidential Green Chemistry Challenge: 2016 Greener Reaction Conditions Award. www.epa.gov/greenchemistry/presidential-green-chemistry-challenge-2016-greener-reaction-conditions-award

² **Yang, M., Y. Fang, D. Sun, and Y. Shi. 2016.** Efficiency of two nitrification inhibitors (dicyandiamide and 3,4-dimethylpyrazole phosphate) on soil nitrogen transformations and plant productivity: a meta-analysis. www.nature.com/articles/srep22075.pdf

DCD (Dicyandiamide)

Data does not support²

“The efficiency of DCD and DMPP under continuously application in one given site is needed to examine. Meanwhile, the impact of their toxicity on plant growth and human health is also needed to study after years of application. Furthermore, the environmental impact of DCD related to the release of [greenhouse gas emissions] from soil still needs more studies to confirm.” This statement was in the conclusion of a meta-analysis conducted on DCD—49 peer-reviewed publications could not determine the toxicity or the environmental benefit of DCD.

Source: Scientific Reports | nature.com

The microbes targeted by DCD, the ammonium oxidizing bacteria, were significantly affected by DCD with reductions in population size and altered activity. In field experiments, Instinct and N-Serve did not reduce numbers of ammonium-oxidizing bacteria (i.e., *Nitrosomonas*).

This statement from peer-reviewed research demonstrates that Optinyte suppresses nitrifying bacteria in the soil, but does not kill bacteria.

Source: Soils and Plant Nutrition Department | Bacteriostatic action of nitrification inhibitors

Rodgers, G. A., and J. Ashworth. 1982. Bacteriostatic action of nitrification inhibitors. *Can J Microbiol.* 28: 1093-1100.

Inoue, K., T. Sakamoto, J. Z. Min, K. Todoroki and T. Toyo oka. 2014. Determination of dicyandiamide in infant formula by stable isotope dilution hydrophilic interaction liquid chromatography with tandem mass spectrometry. *Food Chemistry* 156: 390-393.



SOIL STABILITY

OPTINYTE® TECHNOLOGY (Nitrapyrin)
N-Serve®, Instinct NXTGEN® and Vindicate™ nitrogen stabilizers



Results showed that on average, N leaching decreased by 16 percent and soil N retention increased by 28 percent. In more than 75 percent of individual comparisons, use of a nitrification inhibitor increased soil N retention and decreased N leaching and volatilization.

16%
less
leaching

28%
increase in
soil retention

Source: Wolt, J. D. 2004.

A meta-evaluation of nitrapyrin agronomic and environmental effectiveness with emphasis on corn production in the Midwestern USA.
Nutr. Cycl. Agroecosyst. 69 : 23–41. doi:10.1023/B:FRRES.0000025287.52565.99.

DCD (Dicyandiamide)

susceptible to leaching



DCD is water soluble and can leach away with the first significant rainfall event in contrast to Instinct and N-Serve, which remain in the root zone protecting your nitrogen from losses.

Source: Laboratory evaluation of dicyandiamide as a soil nitrification inhibitor | Communications in Soil

"DCD is readily leached, lowering its effectiveness."

Source: International Plant Nutrition Institute | Nitrification Inhibitors

McCarty G. W., and J. M. Bremner. 1989. Laboratory evaluation of dicyandiamide as a soil nitrification inhibitor. *Comm Soil Sci Plant Anal.* 20: 2049-2065.5

International Plant Nutrition Institute. Nitrification inhibitors. [http://www.ipni.net/publication/nss/nsf/0/21/B8084A341C98E05257E3C0077696B/\\$FILE/NSS-26%20Nitrification%20inhibitors.pdf](http://www.ipni.net/publication/nss/nsf/0/21/B8084A341C98E05257E3C0077696B/$FILE/NSS-26%20Nitrification%20inhibitors.pdf)

Inoue, K., T. Sakamoto, J. Z. Min, K. Todoroki and T. Toyooka. 2014. Determination of dicyandiamide in infant formula by stable isotope dilution hydrophilic interaction liquid chromatography with tandem mass spectrometry. *Food Chemistry* 156: 390-393.



Instinct NXTGEN®

OptiNyte™ technology

NITROGEN STABILIZER

N-Serve®

OptiNyte™ technology

NITROGEN STABILIZER

Vindicate®

OptiNyte™ technology

NITROGEN STABILIZER

For more information, visit **[NUTRIENTMAXIMIZERS.COM](https://www.nutrientmaximizers.com)**
or contact your Corteva Agriscience Territory Manager.



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