

Modern hybrid corn makes better use of nitrogen, study shows

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(Phys.org) -- Today's hybrid corn varieties more efficiently use nitrogen to create more grain, according to 72 years of public-sector research data reviewed by Purdue University researchers.

Tony Vyn, a professor of [agronomy](#), and doctoral student Ignacio Ciampitti looked at [nitrogen](#) use studies for corn from two periods -- 1940-1990 and 1991-2011. They wanted to see whether increased yields were due to better nitrogen efficiency or whether new plants were simply given additional nitrogen to produce more grain.

"[Corn production](#) often faces the criticism from society that yields are only going up because of an increased dependency on nitrogen," said Vyn, whose findings were published in the early online version of the journal *Field Crops Research*. "Although modern hybrids take up more total nitrogen per acre during the growing season than they did before, the amount of grain produced per pound of nitrogen accumulated in [corn plants](#) is substantially greater than it was for [corn hybrids](#) of earlier decades. So, in that sense, the efficiency of nitrogen utilization has gradually improved."

Vyn and Ciampitti's analysis covered about 100 worldwide studies. Of those, 870 data points were taken from the earlier period through 1990, and 2,074 points were taken from studies after 1990, when transgenic hybrids started hitting the market. All studies involved analyses of total nitrogen uptake and grain yield by corn plants at maturity, usually in response to multiple nitrogen application rates.

Grain yields in these research studies averaged about 143 bushels of corn per acre over the last 21 years compared with an average of 115 bushels in the previous 50 years. Those studies showed that in the earlier period, one pound of nitrogen applied to a field produced about 49 kilograms of grain. In the more recent period, the same amount of nitrogen produced about 56 kilograms of grain.

About 90 percent of the corn data points examined in Vyn's study evaluated nitrogen rates between zero and 250 pounds per acre. Over both periods, the average rate of nitrogen fertilizer distributed in experimental fields was nearly the same -- 124 pounds per acre in the earlier period vs. 123 pounds in the later period.

Vyn said genetic improvements have led to [corn](#) plants that require less space around them, allowing growers to squeeze more plants into an acre. Research fields from the modern era averaged about 28,900 plants per acre -- about the average final plant populations in Indiana cornfields in 2011 - compared with 22,800 plants per acre from 1940-1990.

"The maximum individual plant nitrogen uptake stayed exactly the same despite the average gain of 6,000 more plants per acre," Vyn said. "The modern plants are just more efficient at taking nitrogen up and utilizing it than they were before."

Vyn and Ciampitti are working toward methods to increase grain yields further by investigating the contribution of nitrogen to plant biomass and yield formation processes in high-yielding hybrids under a wide range of nitrogen inputs and production stress factors. Knowing that modern hybrids are sustaining a reasonable quantity of nitrogen uptake even under progressively higher plant densities is a good start, Ciampitti said.

"We are getting clues on how plants have already improved nitrogen use efficiency, and we will use that to push for further increases," Ciampitti

said. "We finally feel like we're shedding some light on what traits plant breeders should select for to increase nitrogen efficiency even more."

Vyn and Ciampitti plan to further investigate how water use efficiency and nitrogen use efficiency are tied together, as well as how plants can achieve more tolerance to environmental stresses.

Provided by Purdue University

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