

# A new century in agriculture – the Haber-Bosch process

Let’s go back in time a hundred years: if you were able combine a nitrogen atom with three hydrogen atoms, could you change the world?

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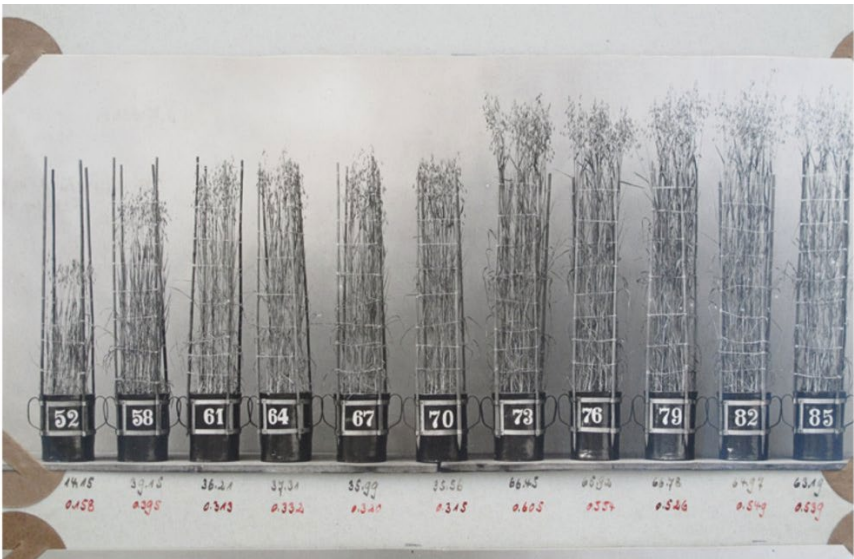


Photo of fertilizer test – showing the improvement of yield – 1919

It is quite paradoxical. Nitrogen is abundantly available in the air we breathe, but it is amazingly useless in this form. That is, of course, a problem because nitrogen is vital for the production of our DNA and other crucial biomolecules (proteins and enzymes).

Nitrogen is definitely crucial to us. Plants also need nitrogen to produce chlorophyll.

That means in reverse: without nitrogen, there would be no photosynthesis, and thus no food production as we know it. Again, it seems quite strange that plants are often hampered in their growth by a lack of nitrogen, although nitrogen is actually abundant. That's because plants cannot do much with the nitrogen in the air, it is not "bioavailable". The stable  $N_2$  connection must be broken up and converted in bioavailable compounds (such as ammonia) so they can use it.

For a hundred years prior to 1908, many scientists had tried in vain to make the nitrogen in the air available for plants. But then Fritz Haber, a German chemist, managed to solve one of the most difficult problems of chemistry at that time by discovering a way to synthesize ammonia. Based on this pioneering discovery, Fritz Haber and Carl Bosch developed an industrial process for the production of ammonia, which became known as the Haber-Bosch process in history. In 1913, BASF in Ludwigshafen put the first commercial plant for ammonia synthesis into operation.

This had far-reaching consequences: The Haber-Bosch process revolutionized farming. Through the use of cheap nitrogen fertilizer farmers achieved a sudden increase in productivity. They increased food production to the degree that they were able to keep up with a population growth unprecedented in the history of mankind. Year after year, farmers mastered the challenge to feed the world population with great results: Not only could food production be secured for more than a century, food also became consistently more affordable.

There is - how could it be otherwise? - a downside: Laughing gas emissions ( $N_2O$ ), soil acidification, and elevated nitrate concentrations in groundwater. These effects are caused by excessive use of organic and synthetic fertilizer. Agricultural techniques for a more efficient fertilizer utilization to reduce runoff, leaching and soil erosion can play a vital role to mitigate the negative impacts and ensure a sustainable agriculture.

The Haber-Bosch process truly changed our world. With almost every meal that we eat, we benefit from it - providing the world with an easy and affordable access to nitrogen.

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