

Nikolai Ivanovich Vavilov: Commemorating Diversity's Geographer

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Abstract

The accomplishments of Nikolai Ivanovich Vavilov continue to be studied almost eighty years after his tragic death. In some ways, it is as if we have not put him to rest, so upsetting is the loss of such an individual. But we must not forget all that Vavilov accomplished in his lifetime, and as "diversity's geographer," he ushered in new ways of thinking of genetic resources and their utility in providing plant immunity. This commentary follows recent articles that speak to Vavilov's worst enemy being agronomic versus political time, and why, given this struggle, that further commemoration at a global scale would be appropriate given his accomplishments. For such an honor, the author asks that Vavilov be considered for a posthumous World Food Prize. While not done so previously, here is an opportunity to honor someone who could not be nominated for the fact that his own adherence to the science of genetics cost him his life.

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showing his understanding of how various sectors of an agricultural economy complement one another [2].

In addition to these contributions, there is of course the genebank, with initial accessions numbering 301 in 1901, and continuing until today, with over 330,000 accessions in 2017, and approximately 15,000 samples tested annually [3,4]. Presently, this genebank now bears his name, as the N.I. Vavilov All Russian Institute of Plant Genetic Resources, or, VIR. It stands as a reminder of the steadfast devotion that Vavilov had for the seeds inurned there, waiting to once again be of service, and the guardians that earlier pledged their very lives to defend [5]. And then there is the unseen-- the remarkable, systematic collection methodology and focus ("Special attention has been devoted to the regions of the primary origin of cultivated plants...," Vavilov, that guided scientific journeys to countries often visited for the first time [6].

It is clear that few contemporary crop scientists have reached this caliber of experience, publication, research and leadership. Had he excelled at one or two, that would have been enough, but he excelled in all areas, and added to these was visionary insight to coming problems such as genetic erosion. Of these many areas, perhaps genetic resources is of greatest significance, for, "He instilled the concept of the genebank, which has become an essential tool of modern plant conservation and breeding," as summarized by Janick [7].

Which brings me back to my examination of the WFP awards; for even after considering such direct ties between productivity and immunity derived from the introgression of related material, and despite the other luminaries that have laid the foundation of conservation before us, there has been no such award for these efforts [8]. Based on my tallies, I found that 12 awards had been made to work involving plant breeding; ten awards for biofortification or nutritional enhancement; 17 awards for policy and development related projects; four awards to integrated pest management, two for soil science; three for biotechnology, and one for post-harvest applications. This totals fifty awards, from the first to the most recent recipient in 2020.

And yet, Vavilov was not only a curator of genebank prototypes, but also one who can discuss in one book topics which today would require a book in themselves [2].

- The geographic basis of breeding
- Vavilov's law on homologous series
- Immunity and specific plant diseases

Introduction

Being invited to reflect on the life of Nikolai Vavilov and the recent article in Crop Science [1], brought to mind the World Food Prize (WFP) and whether or not any recipient had been honored for work in genetic resources. I considered studies from Vavilov's institutes demonstrating how genetic resources provided plants with immunity to any number of pathogens, and many of those still problematic in the developing world. Providing such immunity is one key to preventing crop failure, and hence diminished food harvests.

Literature Review

In particular, for wheat, Vavilov mentions the need for more robust resistance to leaf and stem rust, making clear how advanced the U.S. was at the time in effecting resistance in wheat varieties. He also noted that private breeding efforts had not tackled the study of immunity of wheat, meaning that it had not progressed sufficiently until the creation and financing of "governmental breeding and psychopathological institutes and experiment stations that this question began to be studied,"

- Wheat breeding
- A selected bibliography from the world literature for wheat breeding and genetics.

From the over 360 pages, readers can glimpse not only Vavilov's deep understanding of the sciences for which he was practitioner and administrator, but also his prescience for what comes in the future. For example, when discussing the phytogeographic basis of breeding, he states: "We have barely begun the systematic study of the world's plant resources and have discovered enormous untouched reserves, unknown to scientific breeders in the past Vavilov [2]. The tremendous potential source of species and varieties requires thorough investigation [9].

Here then we find a scientist who was passionate not only about the acquisition of knowledge, but also insisted seeing such knowledge put to use, whether it was in his research programs, within his institutes, or as it affected his own development. Here was a true thirst to find that right combination of know-how, practicality, and knowledge that together was the foundation for saving seed as much as it was to instruct breeding and pathology programs in the hopes of combatting famine. Here then is that rare mix of the theorist and the practitioner, the incarnation of the naturalist-explorer of previous ages, the curator and collector, administrator and director, the visionary and the man of diligence, the geographer and linguist. Could there be such a person today? Vavilov would truly be most difficult to emulate.

Vavilov had either travelled to or been responsible for plant genetic resource collections in over 100 countries, and personally collected approximately 500 species. From and during these travels, Vavilov used his knowledge of geography to begin to mentally map out how to make sense of areas rich in diversity and other areas essentially without such resources.

He would later say, "In summarizing the work of the numerous expeditions" including a total of 60 countries and the entire Soviet Union, together with the detailed comparative study of enormous amounts of material of new species and varieties, we have located eight independent centers of origin of the world's most important cultivated plants," Vavilov. It was in the midst of such theorizing and collecting that Vavilov was captured and never seen again. But what had diversity's geographer left behind? Would their work be able to continue?

Here again we come to another of his remarkable qualities; from ordering heaters to warm his staff in the seed preparation rooms to ensuring orderly filing systems were in place to enter and procure the seeds from, all was in order; so much so that even after Vavilov's arrest, work continued in the genebank, even though the Siege of Leningrad, the work continued. The fact that Vavilov's seedbank, which began around 1900, is still functional and operational is a testimony in itself. Starting from scratch, without rules, guidelines or standards, Vavilov oversaw the development of randomly collected samples into systematic storage based on carefully collecting the relevant genepools for a given area of collection.

And perhaps most importantly, despite however many programs and individuals Vavilov was asked to guide and

oversee, he never lost sight of the importance of being present with his staff, such that he easily inspired those around him. Even after his arrest, his staff remained dedicated to him, and spoke and acted as if he was there among them. It took a man like Stalin to finally silence Vavilov, but in 1955 his name and persona were completely rehabilitated by then Soviet leader, Nikita Khrushchev. Since that time, numerous awards have come his way, stamps issued in his name, and buildings adopting the N.I. Vavilov's name, with the most complete accounting of such honors recently completed [9].

In Crop Science I presented primary forces working upon Vavilov such that it was virtually impossible for him to succeed to the fullest. As this concept of "agronomic versus political time" had not been presented previously, it is important to conclude with it here; for time was not Vavilov's friend. Given the very nature of agricultural crop improvement, especially involving Mendelian plant breeding, time was not going to allow him to see his work through to the end. There, time required would also affect what he would be able to do as an institute director

Conclusion

In closing, I leave readers to weigh the untimely death of one of agriculture's most important figures against his numerous accomplishments; that instead of fading from memory, they should survive and grow in importance. Rather than ending with an image of Nikolai Vavilov as one of the 20,000,000 people to die at the hands of Joseph Stalin, is it not possible that he be worthy of a posthumous award of the World Food Prize?

This would be the ultimate commemorative act for one whose unyielding confidence in the scientific methods he employed ultimately brought about his death. It is time the possibility is discussed. Just as Vavilov's life was restored once by Khrushchev your support can restore it again.

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