



**United State Department of Agriculture
National Institute of Food and Agriculture
Institute of Food Production and Sustainability**

Crop Research Technology Readiness Level (TRL)

The Crop Research Technology Readiness Level (TRL) has been introduced by NIFA for use in the *Supplemental and Alternative Crop Program (SACC)*, *Alfalfa and Forage Research Program (AFRP)*, and *Potato Breeding Research Program* to assess progress in the development of a new technology and communicate the maturity level of a technology from its initial concept to full-scale deployment and commercial use by industry.

The Crop Research TRL was adapted from the National Aeronautics and Space Administration (NASA) TRL system.¹ Like the NASA TRL, the Crop Research TRL has a scale of nine technology readiness levels. TRL 1 is the lowest, indicating the earliest stage of development for a new technology, and TRL 9 the highest, indicating the technology is fully implemented and actively impacting the agricultural economy. The nine-level Crop Research TRL scale progresses through four general *Activities* towards maturity: Preliminary Technology Solution Evaluation, Experimental Testing, Pre-Commercial Assessment, and Commercial Deployment.

Each proposal submitted to one of these three NIFA programs requires a Crop Research TRL assessment of the present readiness status of each technology that is supported through project funding. To determine progress over the course of the award and assist with program level evaluation, an assessment is required describing the readiness of a technology at the beginning of the project, and its expected advancement by the end of the project. Advancement is described by progress from one technology readiness level to another. The nine technology readiness levels are defined by the project director as *Specific Tollgate Accomplishments* based on Generalized Tollgate Descriptions given in the Crop Research TRL Description shown in Table 1. Subsequent annual and final reports will provide assessments of research progress based on the Crop Research TRL using the Specific Tollgate Accomplishments you define.

For each proposal, Table 2 and 3 should be completed and submitted with your application.

The Crop Research TRL also provides a way to coordinate research and monitor progress for entire value chains among multiple research groups and private-public partnerships from field to market. Crop Research TRL should complement the description of the expected outcomes and benefits that are outlined in your proposal. The TRL format replaces the logic model required in earlier RFAs.

¹ NASA (2010). Technology Readiness Levels Demystified.
https://www.nasa.gov/topics/aeronautics/features/trl_demystified.html

Table 1. Crop Research Technology Readiness Level (TRL) Description

Activity	TRL Scale	Description	Generalized Tollgate Descriptions
Preliminary Technology Solution Evaluation	1	Challenge/opportunity identified	The challenge that the industry or other users face, and the need for a new kind of innovation such as variety, practice, or other technology solution.
Preliminary Technology Solution Evaluation	2	Solution or approach formulated	Estimate the value of the innovative solution compared to the existing variety, practice, or other technologies, and where the solution fits in the overall supply chain.
Experimental Testing	3	Proof of concept experiments	Screen germplasm, identify trait, or test other kind of technological innovation of interest to demonstrate its potential added value.
Experimental Testing	4	Field trials or validation experiments	Conduct field trials or other technology performance experiments to determine the potential yield, product quality, operational efficiency, costs and returns or resource quality improvements that would result from the innovation.
Pre-Commercial Assessment	5	Validate commercial acceptance	Conduct field-scale production trials or other on-site technology assessments to determine actual production costs, resource usage, market potential, or other technical limitations including market acceptance.
Pre-Commercial Assessment	6	Full-Scale Production Initiated	Produce certified planting materials or other kinds of technologies and ensure these are available for commercial use and can be sourced for full-scale production.
Commercial Deployment	7	Market Availability	Commercial-scale production by producers or manufacturers occurs with delivery of products to producers, handlers, processors, distributors, or other supply chain participants to market outlets and for meeting user demand.
Commercial Deployment	8	Commercial Use Established	On-going system-level monitoring and research to improve the production system or technology application while managing multiple natural and human resources concerns across entire supply chains.
Commercial Deployment	9	Sustained Production Capacity Achieved	A full array of private and public sector services are available to support system-level production, handling, distribution, and markets across entire supply chains.

Tables 2 and 3 will need to be completed for each submitted project. Table 2 provides the overview for the whole project and documents a broad perspective of what is needed to bring technologies to commercial use. It establishes drivers and ideal end-products, even if a project does not encompass all TRL levels. Table 3 is very specific to your submitted project. Once completed, it will address the individual technologies in your project and describe the desired outcome. Ultimately each technology has a beginning and end for its development, along with an output that are given on TRL Table 3.

Table 2. Crop Research Technology Readiness Level (TRL) Worksheet

Activity	TRL Scale	Description	Generalized Tollgate Descriptions (remove this column when submit proposal)	General Tollgates for your project
Preliminary Technology Solution Evaluation	1	Challenge/opportunity identified	State the challenge that the industry or other users face, and the need for a new kind of innovation such as variety, practice, or other technology solution.	
Preliminary Technology Solution Evaluation	2	Solution or approach formulated	Estimate the value of the innovative solution compared to the existing variety, practice, or other technologies, and where the solution fits in the overall supply chain.	
Experimental Testing	3	Proof of concept experiments	Screen germplasm, identify trait, or test other kind of technological innovation of interest to demonstrate its potential added value.	
Experimental Testing	4	Field trials or validation experiments	Conduct field trials or other technology performance experiments to determine the potential yield, product quality, operational efficiency, costs and returns or resource quality improvements that would result from the innovation.	
Pre-Commercial Assessment	5	Validate commercial acceptance	Conduct field-scale production trials or other on-site technology assessments to determine actual production costs, resource usage, market potential, or other technical limitations including market acceptance.	
Pre-Commercial Assessment	6	Full-Scale Production Initiated	Produce certified planting materials or other kinds of technologies and ensure these are available for commercial use and can be sourced for full-scale production.	
Commercial Deployment	7	Market Availability	Commercial-scale production by producers or manufacturers occurs with delivery of products to producers, handlers, processors, distributors, or other supply chain participants to market outlets and for meeting user demand.	
Commercial Deployment	8	Commercial Use Established	On-going system-level monitoring and research to improve the production system or technology application while managing multiple natural and human resources concerns across entire supply chains.	
Commercial Deployment	9	Sustained Production Capacity Achieved	A full array of private and public sector services are available to support system-level production, handling, distribution, and markets across entire supply chains.	

Table 3. Crop Research Technology Readiness Level (TRL) by technology

No.	Technology	Description of Technology or Problem	Beginning TRL Scale	Ending TRL Scale	Expected Output or Outcome
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					