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Methodological Approach for Screening and Evaluation of Literature using the Rayyan Tool

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DESCRIPTION

This protocol describes a process for use of Rayyan to screen published literature. The technique is embedded into a framework based on PRISMA (Preferred Reporting Items for Systematic reviews and Meta-Analyses). The open source Rayyan tool may be used on a mobile device, tablet or as a web application to screen literature based on title and abstract. In this protocol, we describe a method for gamification of Rayyan screening for rapid and efficient systematic literature reviews. The complete process as described in Koscelny et al, (2026) it is shown in Figure 1, with the key steps utilizing the Rayyan Tool illuminated in red.

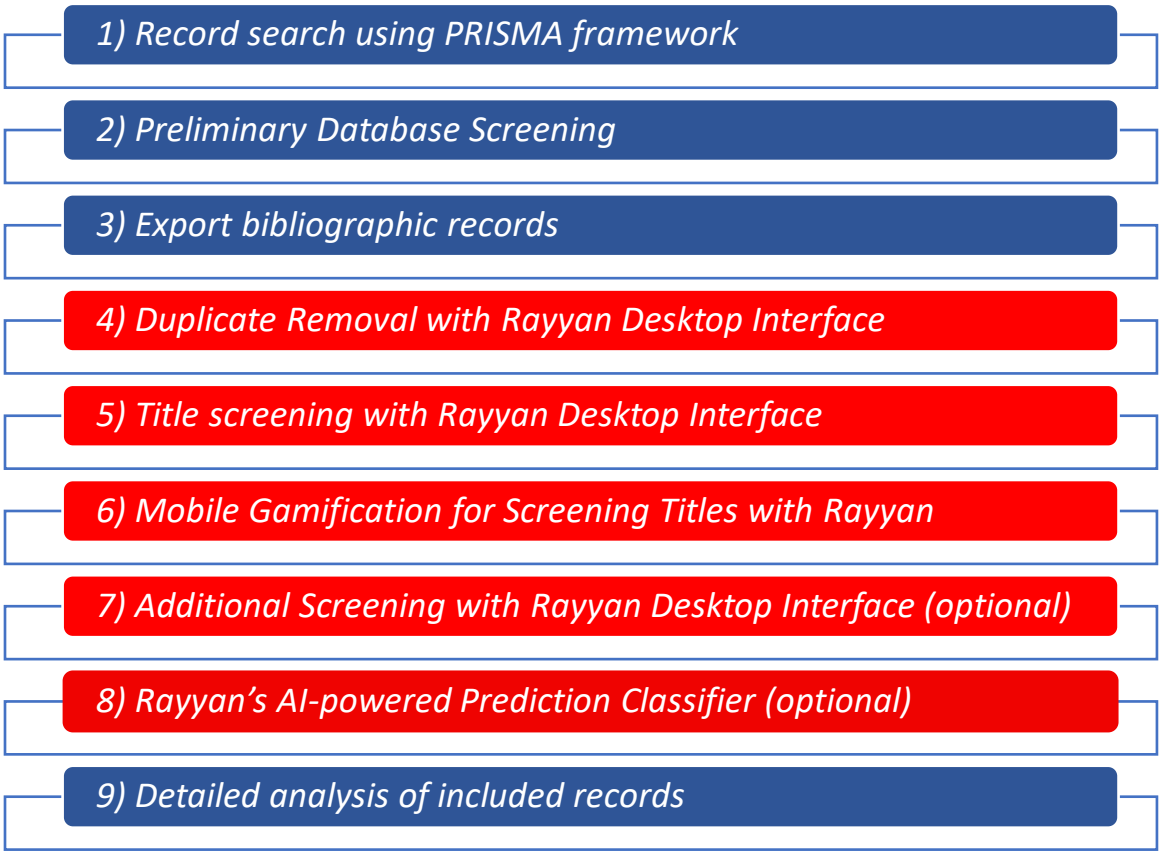

Figure 1. Process flow for systematic reviews using PRISMA approach. The steps for use of the Rayyan tool are highlighted in red.

Keywords: Literature review, identification, screening, inclusion, Rayyan

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GUIDELINES AND WARNINGS

Ethical statement

This study did not involve human subjects and is exempt from ethical approval. Select ethical principles in research synthesis were upheld, including transparency and accurate reporting.

Data management plan

The data management plan herein includes: i) types of data, ii) standards for metadata, iii) archiving metadata, iv) sharing policies, and v) policies and provisions for derivatives.

i) Types of data

Data include bibliographic information from systematic literature review using Web of Science (WoS).

ii) Standards for metadata

Bibliographic data were exported directly from Web of Science (WoS) in .txt file format. No additional metadata standardization was performed. The exported file contains structured bibliographic information, including authors, title, abstract, keywords, publication year, journal name, and citations. This file format preserves the original WoS field organization, which ensures consistency and reproducibility of the review. Metadata are stored as .txt files and were archived as described below.

iv) Sharing policies

All the resources and data are open source. The data do not include PDF files, but links are provided to journal website for access.

v) Policies and provisions for re-use, re-distribution, and production of derivatives

No intellectual property or software are produced in this research.

MATERIALS

The protocol depends on use of the Rayyan tool, which is available at: https:/www.rayyan.ai (Ouzzani et al. 2016)

STEPS

Details for the nine steps shown in Figure 1 are provided below. Steps 4-8 are specific to this protocol (noted in red in Figure 1). Brief information on the other steps is provided below for completeness. Details on the entire process are described in Koscelny et al.

The process is based on a PRISMA-guided systematic review (Page, McKenzie, et al. 2021; Page, Moher, et al. 2021).

Step 1) Record search using PRISMA framework

The first step in a PRISMA-guided systematic review is to establish the central question. In this example, the question was:

"Which electrochemical biosensor approaches have been demonstrated to reliably detect *E. coli* in real or field-relevant matrices applicable to agricultural water, and what analytical performance metrics do they report?"

Next, eligibility criteria are defined. In the example here, studies were included if they:

1. reported an electrochemical biosensor,
2. targeted *Escherichia coli* (any strain or serotype),
3. evaluated performance in real samples or realistic matrices, and
4. were peer-reviewed articles published in English.

The next step in the PRISMA framework is to set the restrictions on publication date. For this example, the publication window was set from 2015 to 2025, with a last acceptance date of May 1st, 2025.

Next, a plan is established for which types of records are to be included. In this example, non-research items (e.g., reviews, book chapters, conference-only abstracts) were excluded. Only peer reviewed publications were included.

Step 2) Preliminary Database Screening

The search engine used for this example was Web of Science (WoS)-All Database, although any search engine that can export results as a .txt file is relevant for this protocol. Search engine filters were applied to refine the results as follows:

- Records were limited to peer-reviewed journal articles in English.
- Records were filtered to only include the top 5 relevant WoS research categories: electrochemistry, nanotechnology, biotechnology, microbiology, environmental sciences, agricultural engineering.
- WoS categories deemed irrelevant were excluded (e.g., physics, business economics, energy fuels, nursing, music) were excluded.

Step 3) Export bibliographic records

The selected records from Web of Science- All Database (Clarivate 2025) were exported directly from the results page using the "Export" function, with the export type set to "Records" in sequential batches of 1,000 records (e.g., 1–1,000, 1,001–2,000) until all results had been exported (Figure 2). Files were saved in EndNote Desktop (txt) format.

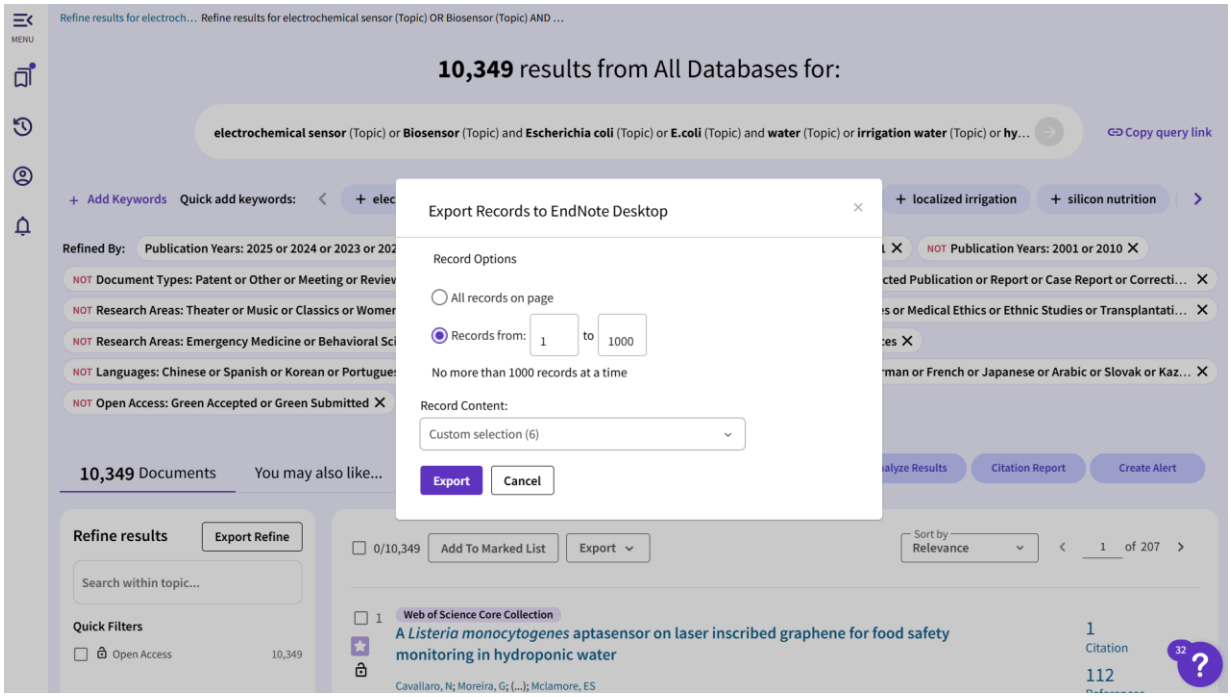

Figure 2. Web of Science (All Databases) export interface showing record-range selection and batch export settings.

Important:

- All selected records were exported from Web of Science in a txt file format. Exported fields included: title, abstract, authors, keywords, source, DOI, and metadata.

Record export fields were customized in the "Record Content" dropdown menu to include the following relevant bibliographic information: title, authors, source, citation count, accession number, and abstract. Figure 3 illustrates the interface for custom export selection of records.

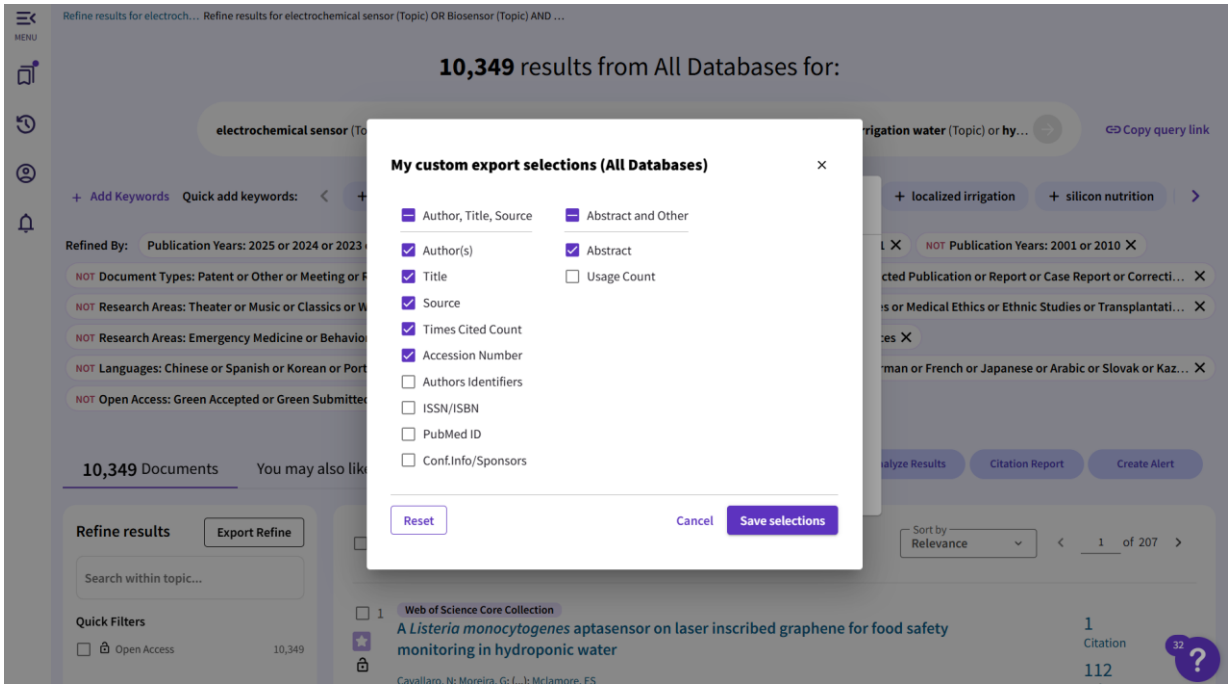

Figure 3. Customized export fields in Web of Science.

All exported files were placed in a single project folder, compressed into a single ZIP file, and uploaded to Rayyan using the import function.

Step 4) Duplicate Removal with Rayyan Desktop Interface

The exported database (ZIP file) was imported into Rayyan (Ouzzani et al. 2016) using the Desktop Interface, where the built-in duplicate detection algorithm was used to identify grouped duplicate records. All duplicate suggestions were manually verified before removal to prevent accidental loss of unique papers (Ouzzani et al. 2016) .

Figure 4 shows a screenshot of the Rayyan tool. In this example, 54 articles from a corpus of 12,436 were flagged as duplicates and reviewed manually.

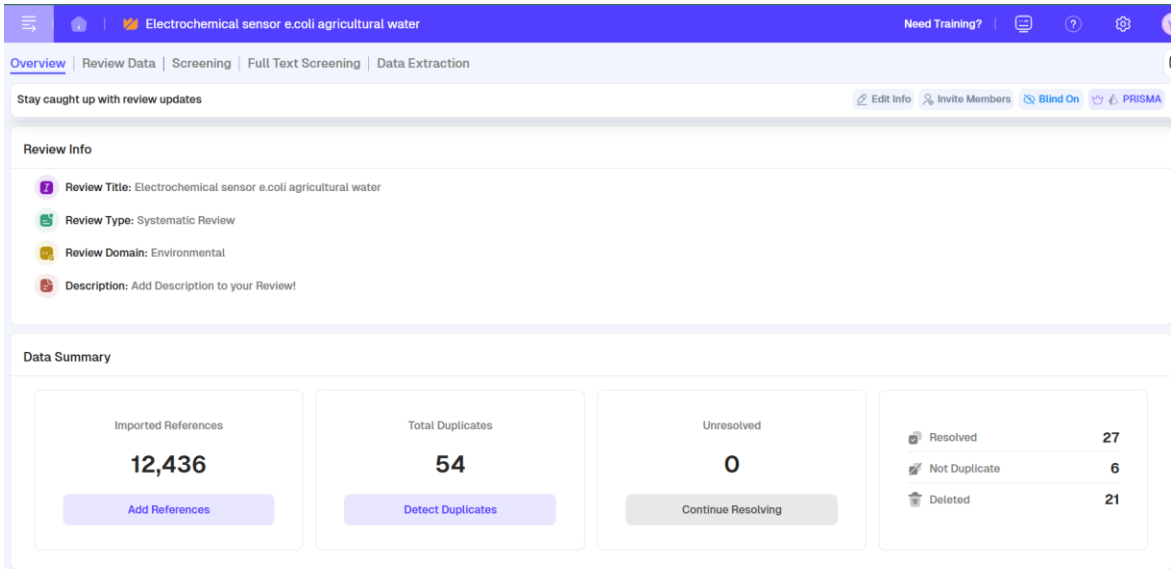

Figure 4. Rayyan duplicate detection view

Critical step:

- Duplicate removal was essential to maintain accurate counts for the PRISMA diagram and to avoid screening the same record multiple times.

Step 5) Title and abstract screening with Rayyan Desktop Interface

Title screening with Rayyan desktop interface used keyword filters to group articles (e.g., "*E. coli*," "*Escherichia*," "electrochemical," "biosensor"). Each title was manually reviewed for relevance.

Figure 5 shows a screenshot of the desktop interface (Ouzzani et al. 2016; Rayyan Systems Inc 2025).

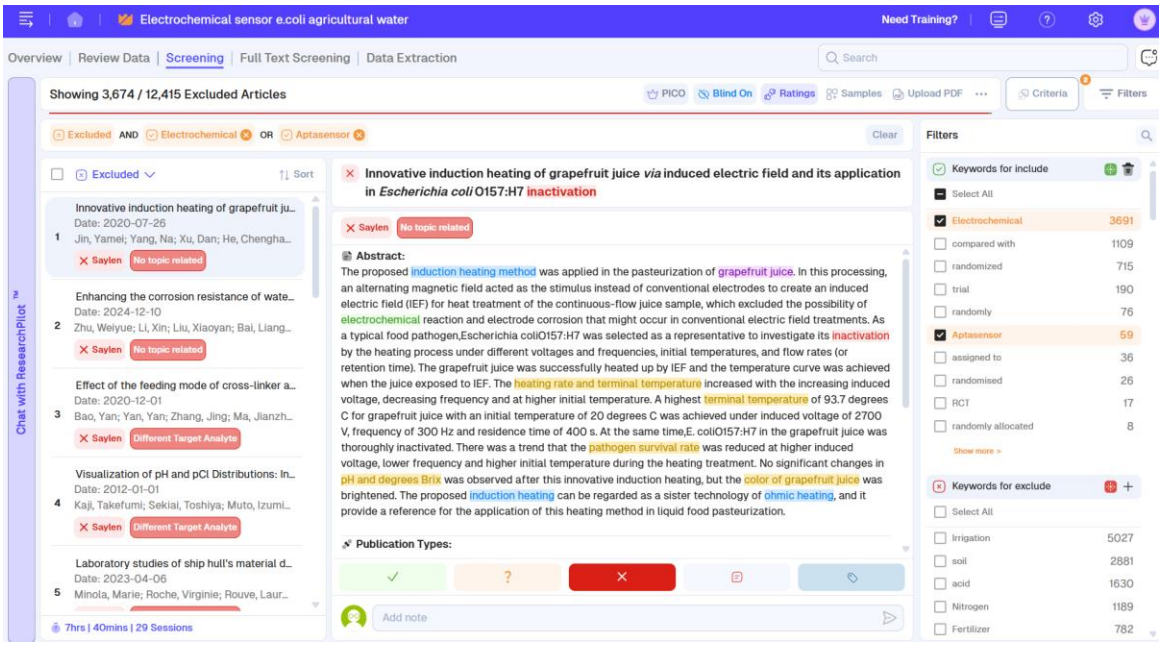

Figure 5. Rayyan desktop interface: *Grouping, Title and Abstract View*

To reduce fatigue, maintain focus, and improve screening speed, two complementary screening approaches were employed depending on the device used: the *"flip"* method on a mobile phone (see Step 6) and the *hotkey-based* exclusion system on a desktop computer (see Step 7).

Step 6) Mobile Gamification for Screening process with Rayyan

Screening decisions were documented using Rayyan Premium (Student Quarterly #SUB-23433) (Ouzzani et al. 2016; Rayyan 2025). A flip-to-include/exclude method was developed for gamification of record inclusion based on Rayyan (See Figure 6).

Participants were informed of the inclusion criteria prior to analysis. Using a mobile phone, participants read the title and then performed a rapid determination as follows:

- **Swipe right → Include**
- **Swipe left → Exclude**
- **Tap Maybe radio button → Revisit record using Desktop method**

This method was designed to increase attention, reduce fatigue, and helped maintain consistent decisions. Using this gamification approach, participants have reported reviewing more than 100 record titles per day.

Uncertain cases were marked as “Maybe” to be revisited using the Desktop method (shown in next section).

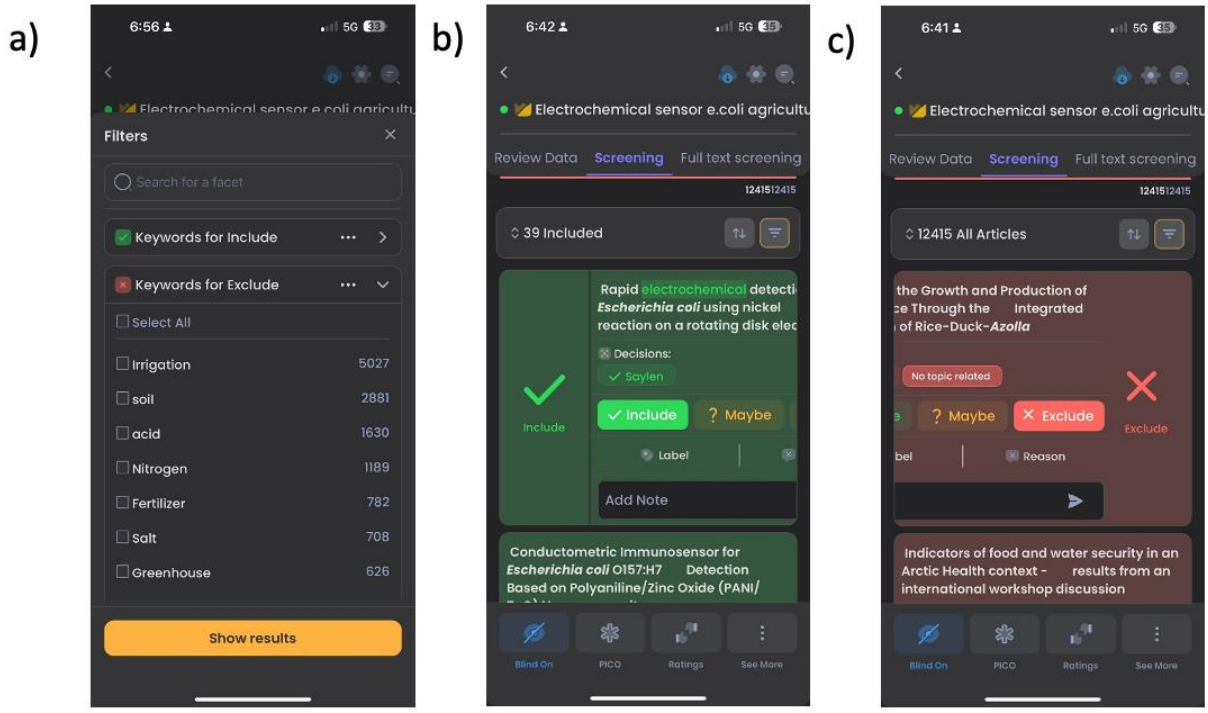

Figure 6. Rayyan Mobile Interface: a) Grouping, Title and Abstract Flip View. The screening of Rayyan’s mobile interface was used strategically to transform screening into a more intuitive and “game-like” task, where swiping left includes a record (panel b) and swiping right excludes a record (panel c).

Step 7) Additional Screening with Rayyan Desktop Interface (optional)

Records not easily identified with the gamification technique were screened using the Rayyan Desktop tools.

This protocol used a hotkey-based exclusion method with written explanation(s).

Critical step:

- The Rayyan premium tool is required for use of the written explanation feature during screening.

Screening decisions were documented using Rayyan Premium’s (Student Quarterly #SUB-23433)“*Exclude with Reasons*” tool. This allowed for transparent justification and reproducible exclusion.

Keyboard shortcuts were used to increase speed and maintain consistency during the screening process**:**

Hotkey	Meaning	Exclusion Reason Description
n	Not relevant to topic	Used when the study did not involve biosensors or was unrelated to electrochemical detection.
t	Different target analyte	Used when the analyte was not Escherichia coli (e.g., other bacteria, viruses, or chemical contaminants).
r	Review article	Used for narrative reviews, systematic reviews, or meta-analyses rather than primary research papers.
e	No electrochemical method	Used when the study did not use an electrochemical method as a transduction mechanism

The hotkey codes are applied directly during screening with the Rayyan interface (see Figure 7 for screenshot example). Rayyan automatically assigns each paper to the corresponding exclusion category based on the established hotkey configuration.

a)

b)

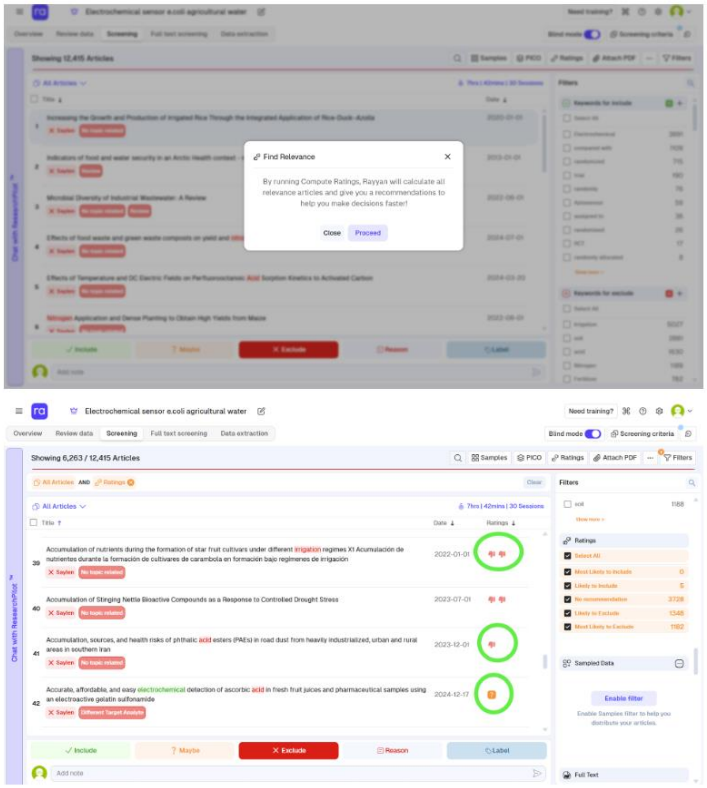

Figure 7. Desktop Screening "Exclude with Reasons" Panel: Title and Abstract View.

Step 8) Rayyan's AI-powered Prediction Classifier (optional)

The AI-powered Predictions Classifier within Rayyan was enabled to assist with prioritizing and cross-validation (See Figure 8a). The tool was used to rank the records based on how likely they are to be included in the review, based on the patterns identified during review (See Figure 8b).

In this protocol, automated predictions were not used to make exclusion decisions, although this is an option with the software (Ouzzani et al. 2016; Rayyan Systems Inc 2025). For this protocol, all records were manually assessed by participants to ensure accuracy.

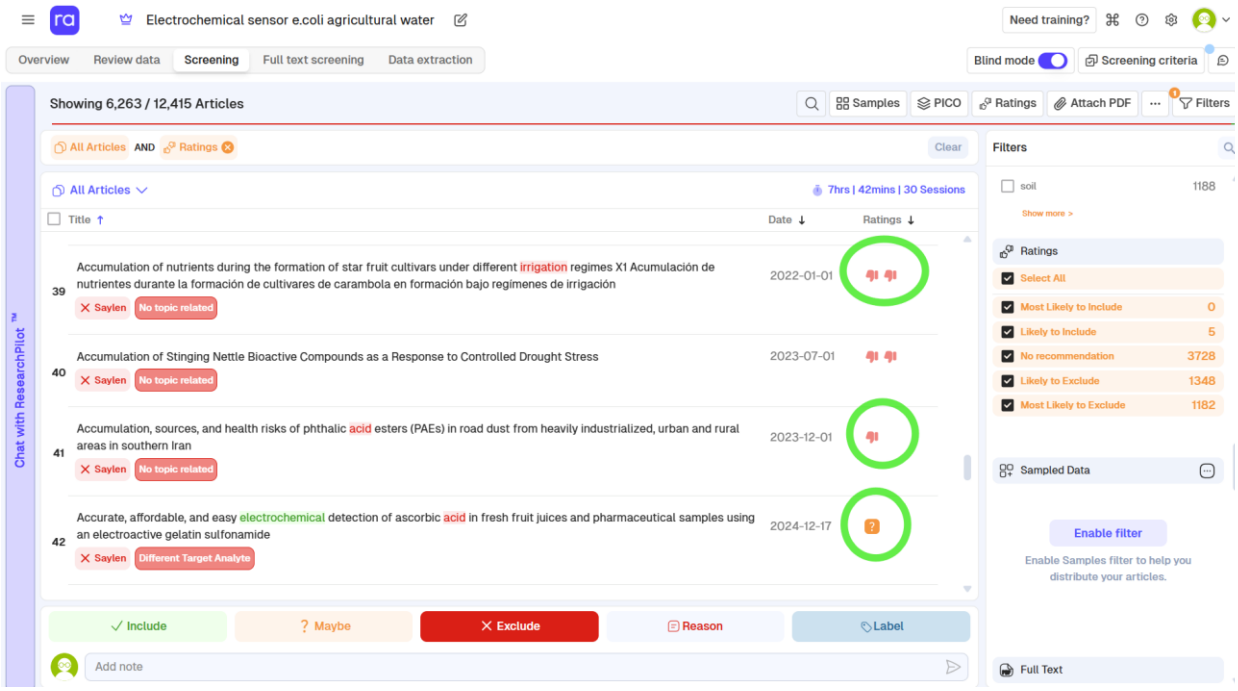

Figure 8. Rayyan relevance prediction feature showing rating definitions and relevance score output for screened records. (two thumbs up): Most likely to include: Articles with the highest probability of inclusion. (one thumb up): Likely to include: Articles with a high probability of inclusion. (question mark): No recommendation: The AI doesn't have enough information to make a confident prediction. This is common early in the screening process. (one thumb down): Likely to exclude: Articles with a high probability of exclusion. (two thumbs down): Most likely to exclude: Articles with the highest probability of exclusion.

Step 9) Detailed analysis of included records

Once the Rayyan screening was complete, each record included in the study was processed in detail by the research team.

To avoid reviewer fatigue (Polanin et al. 2019), a careful plan should be established for detailed analysis of all records included. An example is summarized below.

Each paper is read thoroughly by at least one member of the research team. The analysis goal is two papers per day. Key information is manually extracted from each record, focusing on elements that align with the objectives of the literature review, including:

- Methodology used in the study
- Main findings and conclusions

- Limitations
- Future directions

The inclusion/exclusion data were anaylzed and a PRISMA flowchart prepared for visualizing the systematic review.

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