

ADMINISTRATIVE INFORMATION

Title Identification

1a. Identify the report as a protocol of a systematic review:

Title is “A bibliographic network analysis and systematic literature review on the effect of heat stress on milk production in dairy cows “

Update

1b. If the protocol is for an update of a previous systematic review, identify as such:

n/a

Registration

2. If registered, provide the name of the registry (e.g., PROSPERO) and registration number:

n/a, not registered. The protocol is included in supplementary material and a project description available on the Primary Industries Climate Challenges Centre (PICCC) website, <https://www.piccc.org.au/research/theme/adaptation>

Authors Contact

3a. Provide name, institutional affiliation, and e-mail address of all protocol authors; provide physical mailing address of corresponding author:

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Contributions

3b. Describe contributions of protocol authors and identify the guarantor of the review:

Dr. Rachelle Meyer developed this review protocol which was reviewed by Dr. Ann-Maree Graham and Prof. Richard Eckard. Dr. Meyer is the guarantor of the review.

Amendments

4. If the protocol represents an amendment of a previously completed or published protocol, identify as such and list changes; otherwise, state plan for documenting important protocol amendments:

No Amendments

Support Sources

5a. Indicate sources of financial or other support for the review Sponsor:

This work is being conducted under the Forewarned is Forearmed (FWFA) project (codes MLA B.CCH.8110 and RnD4Profit-16-03-007)

5b. Provide name for the review funder and/or sponsor Role of sponsor/ funder:

The FWFA project is supported by funding from the Australian Government Department of Agriculture and Water Resources as part of its Rural R&D for Profit programme.

5c. Describe roles of funder(s), sponsor(s), and/or institution(s), if any, in developing the protocol:

Funders had no role in developing the review protocol

INTRODUCTION

Rationale

6. Describe the rationale for the review in the context of what is already known:

As climate change increases the frequency and severity of heatwaves, understanding the current state of knowledge on heat stress and milk production is critical for mitigating impacts and strategically targeting future research efforts. This systematic review will focus on articles addressing heat stress and dairy cow milk production. The synthesis allows for identification of trends, for instance in the effectiveness of interventions, and sources of variation in heat stress response.

Objectives

7. Provide an explicit statement of the question(s) the review will address with reference to participants, interventions, comparators, and outcomes (PICO):

This systematic review addresses dairy cows' response to heat stress in comparison to controls, differing management or ambient temperatures over time, solely in terms of impacts on milk production in the immediate to short-term. A narrative synthesis of impacts of heat stress during the dry season on subsequent lactation(s) will be provided, however the systematic review will be limited to acute heat stress response.

PICO:

Participants: Dairy cows

Intervention: Heat Stress

Comparators: Controls (thermoneutral), management options (shade, fans/spray, evaporative cooling), exposure to various ambient conditions (comparing varying levels of heat stress), or any other comparison made. Studies recording production under one temperature/THI condition only, will not be included.

Outcomes: short-term impacts on milk production

METHODS

Eligibility criteria

8. Specify the study characteristics (e.g., PICO, study design, setting, time frame) and report characteristics (e.g., years considered, language, publication status) to be used as criteria for eligibility for the review:

All English language articles published from 1990 to 2017 and cited an average of twice per year as of January of 2018 that include data on impact of heat stress (I) on milk production (O) in dairy cows (P) are eligible for the systematic review regardless of the heat stress comparison (C).

Information sources

9. Describe all intended information sources (e.g., electronic databases, contact with study authors, trial registers, or other grey literature sources) with planned dates of coverage:

Journal articles and other reports published from 1990 through 2017 with an average of 2 citations per year.

Search strategy

10. Present draft of search strategy to be used for at least one electronic database, including planned limits, such that it could be repeated:

Web of Science search:

Topic: ('Milk production' Or 'Milk quality') AND ('Heat stress' OR 'Extreme heat')

Published in the English language between 1990 and 2017.

Citations from this search will be used in a network analysis of the literature. Eligibility for the systematic review includes being cited twice per year on average and reporting the details of some heat stress occurrence and its impact on milk production in dairy cows. Articles cited by reviews that meet these criteria but do not occur in the Web of Science search are eligible for the systematic review.

Study records: Data management

11a. Describe the mechanism(s) that will be used to manage records and data throughout the review:

Endnote will be used to track citations and an Excel spreadsheet will be used to record data (#12) for each eligible article

Selection process

11b. State the process that will be used for selecting studies (e.g., two independent reviewers) through each phase of the review (i.e., screening, eligibility, and inclusion in meta-analysis):

The average citation rate will be determined following the Web of Science literature search and bibliographic network analysis. Articles cited less than twice per year on average, will not be included in the systematic review. Any results from the Web of Science search identified as review articles will be screened for data regarding milk production response to heat stress in dairy cows. Any articles cited in the review articles that meet the above criteria are eligible for the systematic review, even if they do not occur in the Web of Science search results. All articles that only have data on species other than dairy cows will be excluded. Any articles without data on the response of milk production (e.g. impacts on fertility, etc) to heat stress will also be excluded. Articles that meet the eligibility criteria will be added to the Excel document for systematic review.

Data collection process

11c. Describe planned method of extracting data from reports (e.g., piloting forms, done independently, in duplicate), any processes for obtaining and confirming data from investigators:

Each eligible article will be examined based on the questions below (#12) and answers recorded in an Excel spreadsheet. Notes regarding missing information will be reported in the systematic review.

Data items

12. List and define all variables for which data will be sought (e.g., PICO items, funding sources), any pre-planned data assumptions and simplifications:

Information on the following questions will be collected from each article included in the systematic review:

- Where was the study performed?
- What breed of cows were investigated?
- Chamber or Field?
 - If field data the type (e.g. test day records, national databases, pasture experiments)
- Scale (e.g. National, regional, farm/herd, individual cows)
- Experimental details including details of control group (length of experiment or amount of test record data used)

- Data analysis methodology used (statistical analysis of data, development of statistical model from data (linear, broken stick, fixed effect)).
- Which heat stress indicator used?
 - If THI, what THI formula was used
- Threshold effect of heat stress assumed or calculated? What thresholds assumed? What are the calculated thresholds?
- Where any economic impacts calculated?
- Cow characteristics included? Which ones? (Lactation stage/days in milk, breed, genetic traits, colour, productivity class)
- Farm characteristics included? Which ones? (Production type, housing, adaptations incorporated such as shade, evaporative cooling, fans/spray)
- Nutrition effect included?
- Other experimental treatments (e.g. bST, rbST)
- Effect of heat detectable (yes or no)?
- Size of effect?
- Does it include future climate scenarios?
 - If so, what climate scenario? (What climate model and emission scenario)
 - What was the methodology for estimating frequency and intensity of heat waves?
 - What farm model was used?
 - What was the effect size of future heat waves on milk production?
- Research gaps, next steps specifically mentioned (this will also be recorded for the articles identified as reviews, results of which will be included in a narrative synthesis)

Outcomes and prioritization

13. List and define all outcomes for which data will be sought, including prioritization of main and additional outcomes, with rationale Risk of bias in individual studies:

The outcomes are impacts on milk production alone. The main outcomes being the extent to which heat stress impacts milk production in various situations. Other included variables assist in explaining the variation in responses within and across studies as well as effectiveness of management responses to heat stress.

14. Describe anticipated methods for assessing risk of bias of individual studies, including whether this will be done at the outcome or study level, or both; state how this information will be used in data synthesis:

Details of study methodology will address bias at the study level and general details of the study will assess bias at the outcome level (for instance, disproportionate representation of breeds and locations).

Data Synthesis

15a. Describe criteria under which study data will be quantitatively synthesized:

Quantitative assessments will include percent reduction in milk yield associated with heat stress, whether this is reported as percent reduction or calculated from values reported in the article. Additionally, if impact of heat stress per increase in THI unit or degree C in temperature is reported in any study, the information will also be recorded in the Excel file.

15b. If data are appropriate for quantitative synthesis, describe planned summary measures, methods of handling data, and methods of combining data from studies, including any planned exploration of consistency (e.g., I², Kendall's tau):

The summary of quantitative values from the literature will focus on trends between effect size and study design or methodology. Data from different studies will not be combined for any analysis.

15c. Describe any proposed additional analyses (e.g., sensitivity or subgroup analyses, meta-regression):

No other quantitative analyses will be conducted.

15d. If quantitative synthesis is not appropriate, describe the type of summary planned:

In cases where information collected is not conducive to quantitative analysis (impacts during late gestation, climate change impacts, etc), narrative syntheses, including the broad trends and exceptions to those trends, will be developed.

Meta-bias(es)

16. Specify any planned assessment of meta-bias(es) (e.g., publication bias across studies, selective reporting within studies):

Aspects of meta-bias, including over-representation of locations and institutions, will be addressed through a bibliographic network analysis of the literature more broadly, as well as tracking characteristics of the articles included in the review.

Confidence in cumulative evidence

17. Describe how the strength of the body of evidence will be assessed (e.g., GRADE):

Although not the focus of this review, the strength of the body of evidence will be assessed primarily through consistency in findings across studies in differing locations and using differing methodologies. The primary focus of this review will be identifying sources of variation in the response to heat stress, particularly effect size. Avoidance of 'Indirectness of evidence,' by only including studies addressing the milk production response to heat stress in dairy cows, will support the strength of evidence of the review. No meta-analysis of data across studies will be performed. Therefore, imprecision is only a concern within the studies reviewed, not of the systematic review itself. Methodological issues that could lead to bias of individual studies or in aggregate (i.e. predominance of Holsteins) will be tracked in the Excel document. Publication bias will likely be the main source of bias in this review, as publications with a significant effect are more likely to be published. Requiring 2 citations per year since publication excludes articles that have not been cited due to a lack of quality but does risk exclusion due to researchers' inclination to cite literature showing a significant effect of heat stress. In addition, it may also exacerbate the geographical bias and limit case study type analyses which are often published in conference proceedings or regional journals that are less likely to be cited.