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ORIGINAL PAPER

The use of plant-based bioassays in homeopathic basic research

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Objectives: **The objective was to evaluate homeopathic basic research studies that use plant-based bioassays. With this in view, a compilation was made of the findings of three systematic literature reviews covering plant-based bioassays in the three fields of healthy, abiotically, or biotically stressed plants. This compilation focused on investigations using advanced experimental methods and detailed descriptions, also with the aim of supporting the design of future experiments.**
Methods: **Publications included had to report on studies into the effects of homeopathic preparations on whole plants, seeds, plant parts and cells. Outcomes had to be measured by established procedures and statistically evaluated. A Manuscript Information Score (MIS) was applied using predefined criteria to identify publications with sufficient information for adequate interpretation (MIS ≥ 5). Additional evaluation focused on the use of adequate controls to investigate specific effects of homeopathic preparations, and on the use of systematic negative control (SNC) experiments to ensure the stability of the bioassay. Only a fraction of the studies reported here were performed with 'ultra high' dilutions, whereas other studies were performed with moderate or high dilutions.**
Results: **A total of 157 publications were identified, describing a total of 167 experimental studies. 84 studies included statistics and 48 had a MIS ≥ 5, thus allowing adequate interpretation. 29 studies had adequate controls to identify specific effects of homeopathic preparations, and reported significant effects of decimal and centesimal homeopathic potencies, including dilution levels beyond Avogadro's number. 10 studies reported use of SNC experiments, yielding evidence for the stability of the experimental set-up.**
Conclusion: **Plant models appear to be a useful approach for investigating basic research questions relating to homeopathic preparations, but more independent replication trials are needed in order to verify the results found in single experiments. Adequate controls and SNC experiments should be implemented on a routine basis to exclude false-positive results.** *Homeopathy* (2015) **104**, 277–282.

Keywords: Review; Basic research; Homeopathy; Potentisation; Agriculture; Phytopathological models; Field trials; Impaired plants; Noxa

Introduction

Over 1000 experimental studies have previously been published in the field of basic homeopathic research.[1] The three major areas of homeopathic basic research

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Table 1 Assessment of the manuscript information content by a MIS. A maximum of 10 points were given for 5 category groups. A minimum of 5 points was necessary for the study to be included in the review

MIS Score	*Fully described 2 points*	*Partly described 1 points*	*Not mentioned 0 points*
Experimental setup	Detailed information is given: mode of treatment of plants, growth period, time of measurements, etc.	Only some details are described or only a little information about the set-up is given	No information is given about the experimental set-up
Materials	All materials used in the experiment are described with trade name, etc.	Some materials used in the experiments are described or mentioned	No information is given about the materials used
Measuring instruments	Measuring instruments are described in detail, operation mode, trade name, type, etc.	Measuring instruments are only mentioned	There is no information about measuring instruments in the paper
Potentisation	Potentisation technique, date and time of potentisation and potentisation medium are described in detail	Some information about potentisation technique is given	No information about potentisation; only the potentised test substance is mentioned
Controls	Detailed information, e.g.: sterile distilled water from the same batch of distilled water.	Some information about the sort of control is given: e.g.: water control	Controls are not mentioned or not done

with plants have recently been reviewed. The first review of experimental studies on healthy plants was published by Majewsky *et al.*[2] Betti *et al.*[3] published a review of plants infected by viruses or bacteria (phytopathological models) and Jäger *et al.*[4] published a review of studies on abiotically stressed plants. In this publication we have compiled the three Reviews to give an overview of the complete field of homeopathic Basic Research with plants up to 2010. For Information on further studies up to 2015, see the contribution on repetitions of fundamental research models in ultra high dilutions by Endler *et al.* in this issue.

Methods

In the three reviews,[2–4] a search of the literature considered publications that reported homeopathy experiments using healthy plants, plant pathological models (*in vitro* and *in planta*), plant field trials and abiotically stressed plants, and involved whole plants, seeds, plant parts and cells. Outcomes had to be measured by established procedures and statistically evaluated. Using a Manuscript Information Score (MIS), publications were identified that provided sufficient information for proper interpretation (MIS $\geq$ 5, Table 1). A further evaluation was based on the use of adequate controls to investigate specific effects of homeopathic preparations and on the use of systematic negative control (SNC) experiments.

Only a fraction of the studies reported here were performed with 'ultra high' dilutions, whereas other studies were performed with moderate or high dilutions.

Results

The studies included were conducted from 1920 (healthy plants), respectively 1965 (abiotically stressed plants) and 1969 (plant pathological models) to 2009, respectively 2010 (abiotically stressed plants). In 157 publications a total of 167 experimental studies were described. 84 studies (50% of all studies) included statistics and 48 studies (29% of all studies) had a MIS $\geq$ 5 allowing adequate and detailed interpretation. 29 studies (17% of all studies) had adequate controls to identify specific effects of homeopathic preparations, and reported significant effects of homeopathic potencies, including dilution levels beyond Avogadro's number. 10 studies (6% of all studies) involved the use of SNC experiments (Table 2).

For the publications with MIS $\geq$ 5 (48 studies), further detailed information was extracted. The plant primarily used in these 48 experiments was wheat (23 studies). Dwarf peas and duckweed were used in 3 studies each. Other plant organisms were used in no more than one or two studies. The most widely administered homeopathic preparation was silver nitrate (9 studies), followed by arsenic (8 studies), gibberellic acid (6 studies) and cina (4 studies). Other preparations were utilized in one, two or three studies at most. The most applied stressor was arsenic (6 studies). Other stressors were used in one, two or no more than three studies. Widely varying measurement parameters were used, but in all three fields (healthy, abiotically, or biotically stressed plants), number and size of plants, parts of plants or pathogenic organisms were measured. In some studies the concentration of plant secondary metabolites[5] or other biochemical substances[6,7] was used as outcome parameter. Furthermore the idea of using variability instead of mean values to measure the effects of homeopathic preparations has taken place.[8,9] In four model systems a consistent reduction of variability was found when investigating the effects of Arsenicum

Table 2 A total of 167 experimental studies were included in the review process

Studies	*Healthy plants*	*Phytopathological models*	*Abiotically stressed plants*	*Total*
Identified	86	44	37	167
With statistics	43	19	22	84
MIS $\geq$ 5	29	6	13	48
With adequate controls	15	6	8	29
With SNC experiments	5	1	4	10