

Are we making significant progress in mechanical weed control research?

J. Rasmussen

Department of Agricultural Science, The Royal and Veterinary and Agricultural University,
Højbakkegård Allé 13, DK-2630 Taastrup, Denmark

Abstract

This study investigates whether researchers' perceptions of good research are in agreement with current research practice as reflected in *Weed Research*. A high degree of agreement is assumed to indicate progress.

The instrument used to survey researchers' perceptions was a questionnaire consisting of 28 items related to (1) research methodologies, (2) research priorities, (3) quality of publications, (4) future developments in technology and agriculture and (5) general attitudes to alternative and conventional agriculture. Questions about gender and personal research engagement were also laid down in the questionnaire. The questionnaire was sent out by e-mail to about 140 researchers on the mailing list of the EWRS – Physical and Cultural Weed Control Group and 60 questionnaires were completed and returned. An analysis of all *Weed Research* publications in the period 1998-2003 investigated current research practices.

The questionnaire showed that researchers in the working group are not specialized. Of the respondents, only 4 researchers (7%) used 50% or more of their research hours on mechanical weed control but a total of 44 researchers (73%) were active within this area.

Views on research and agriculture varied significantly within the group and two counter paradigms were identified often referred to as alternative and dominant. The alternative paradigm was connected with organic farming and the dominant paradigm was connected with conventional agriculture. Alternative paradigmatic positions prevailed among the respondents although strong dominant positions were also represented. Females (N=15) held more alternative positions than males ($P < 0.01$) and researchers engaged in herbicide technology (N=13) held more dominant positions than the rest ($P < 0.05$).

By using an alternative-dominant scale, it was evident that respondents' perceptions of good research was linked to basic values and beliefs that determine the overall understanding of how agriculture works and should be developed. Alternative perceptions of good research, however, seemed to be inconsistent with the current research practice as reflected in *Weed Research*. Consistency between ideals and reality should result in (1) more multidisciplinary studies to facilitate broader perspectives on weed control, (2) more studies carried out on working farms, (3) more system approaches that include whole agro-ecosystems with farmers and other stakeholders, (4) value inquiries, (5) participative research and (6) reflective approaches. Papers published in *Weed Research* clearly demonstrate, that alternative research in the ideal is different from research in reality. The main difference between alternative and dominant research is in what gets studied, not in how it is studied.

In conclusion, research in physical and cultural weed control may be evaluated successful in a dominant paradigmatic perspective but progress is very limited in an alternative paradigmatic perspective. There seems to exist a mismatch between ideals and reality in weed research, which challenges ideals as well as practice.

Introduction

Mismatches between ideals and reality are challenging. If not considered, they may impede progress. If considered, they may develop ideals as well as practice.

This study aimed to investigate whether there exist mismatches in the EWRS – Physical and Cultural Weed Control group regarding perceptions of good research (the ideal) and conducted research (the reality).

The following text and table briefly adds some details to the abstract. The text constitutes not a full paper. A comprehensive presentation including results from other EWRS working groups will be published later in a journal.

Materials and methods

The questionnaire was constructed on the basis of three main sources that relate to the alternative–dominant paradigmatic understandings of agriculture and research: (1) the Alternative-Conventional Agricultural Scale developed to measure basic beliefs and values assumed to constitute two competing perspectives in agriculture (Beus and Dunlap, 1991), (2) Lockeretz and Anderson's (1993) analysis of alternative agricultural research and (3) the concepts behind the farming systems approach developed in Australia (Packham, 2003).

Seven bipolar statements were copied from the Alternative-Conventional Agricultural questionnaire developed by Beus and Dunlap (1991) to constitute the first group of items (20, 22, 23, 24, 25, 26, and 27 in Table 1), nine bipolar statements were formulated on the basis of Lockeretz and Anderson's (1993) and Packham's (2003) work to constitute the second group of items (1, 2, 3, 4, 5, 11, 13, 14, and 15 in Table 1) and twelve bipolar statements were formulated to get insights into the respondents' general perception of research priorities, publication quality, and expected future developments in technology and agriculture (items 6, 7, 8, 9, 10, 12, 16, 17, 18, 19, 21, 28 in Table 1). The bipolar items in the first and second group, which were supposed to portray the respondents' paradigmatic positions to agriculture and research, were randomly reversed in direction in the questionnaire. Sometimes the alternative statement was in the left column and sometimes it was in the right column. Some items presented completely opposite positions, while the positions in others were not totally opposite but were designed to accurately portray of the contrasting (but not necessarily diametrically opposed) positions.

Agricultural paradigms reflect coherent frameworks of knowledge, values and beliefs that determine people's overall understanding of how agriculture works and should work in the future. Paradigmatic consistency, which expresses the strength of the framework, was tested according to the procedures given in Rasmussen and Kalsoft (2003).

Results

The first two groups of items were shown to be suitable to quantify respondents' paradigmatic position on an alternative-dominant scale. The paradigmatic consistency was very high for items in the first group (general attitudes) and somewhat lower in the second group (specific attitudes to research methodology). All items, however, were tested to be suitable to portray paradigmatic position on an alternative-dominant scale.

Table 1 presents the questionnaire and the frequencies of 60 respondents' answers.

Table 1. Questionnaire about future directions in weed research and agriculture. Frequencies of given answers (N=60) are given in the questionnaire. For each pair of contrasting views, the respondents were asked to indicate which one of the two views they most agree with – the one in the left column or the one in the right hand column – by crossing the appropriate number:

1 = STRONGLY AGREE WITH THE VIEW IN LEFT HAND COLUMN

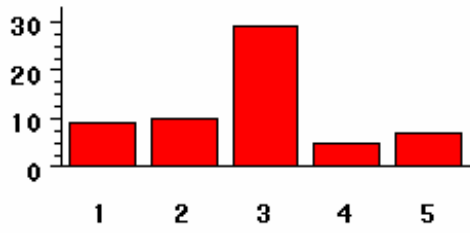
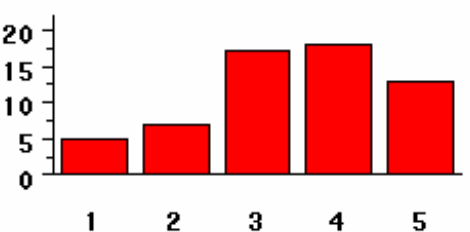
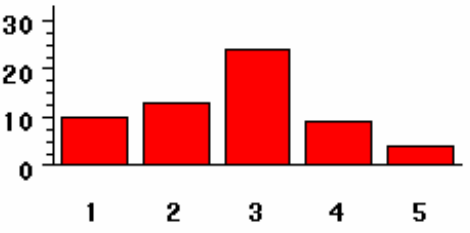
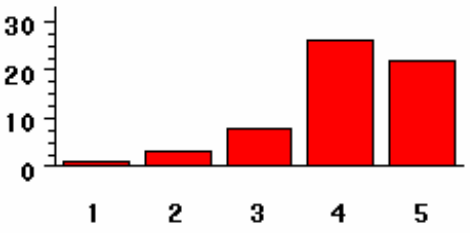
2 = MILDLY AGREE WITH THE VIEW IN LEFT HAND COLUMN

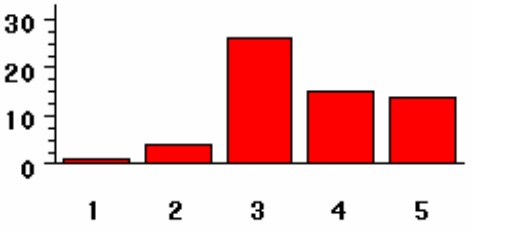
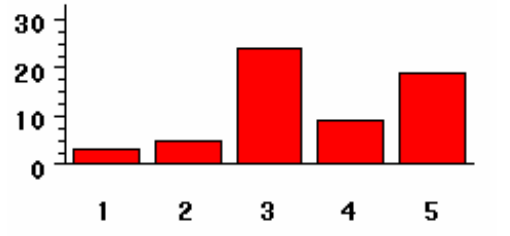
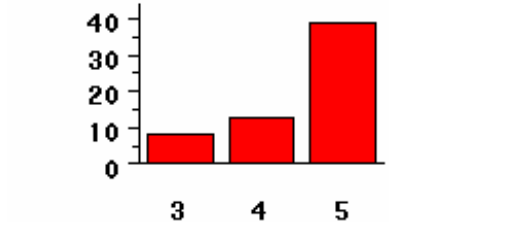
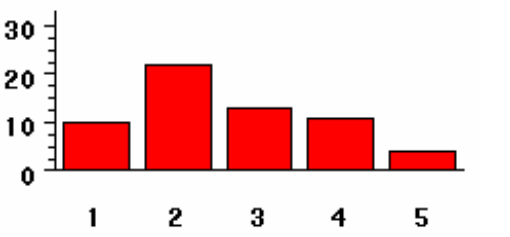
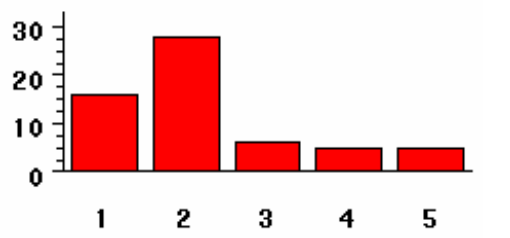
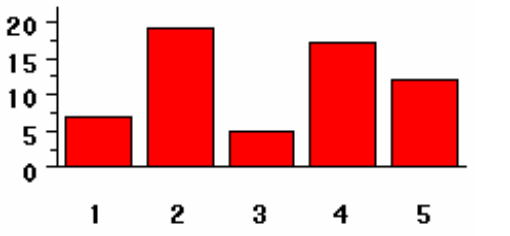
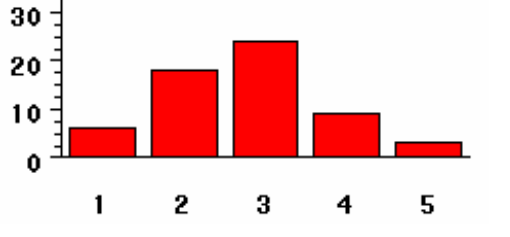
3 = AGREE WITH BOTH

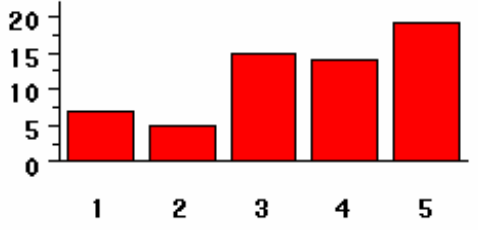
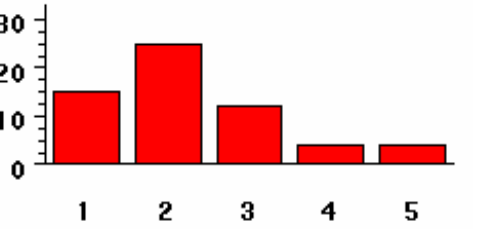
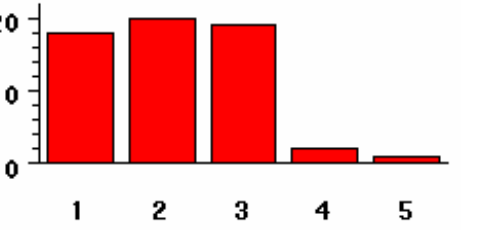
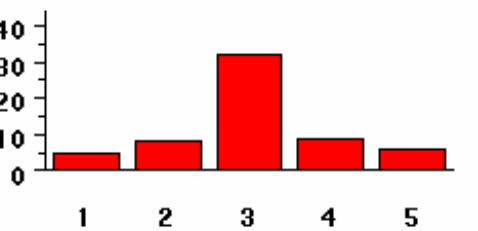
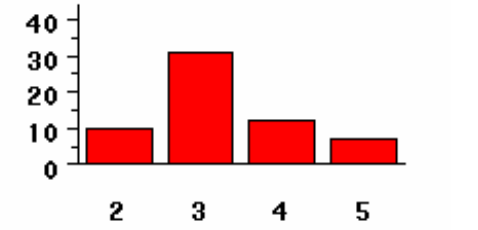
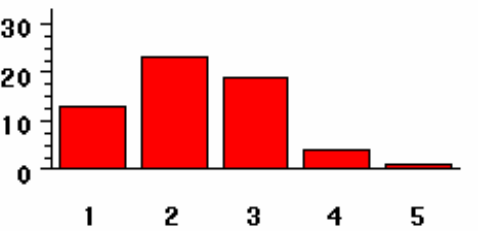
4 = MILDLY AGREE WITH THE VIEW IN RIGHT HAND COLUMN

5 = STRONGLY AGREE WITH THE VIEW IN RIGHT HAND COLUMN

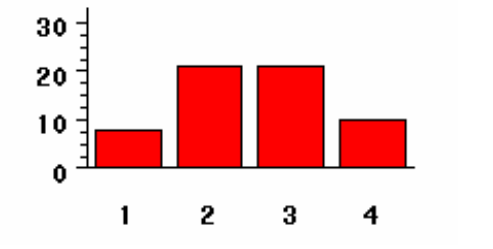
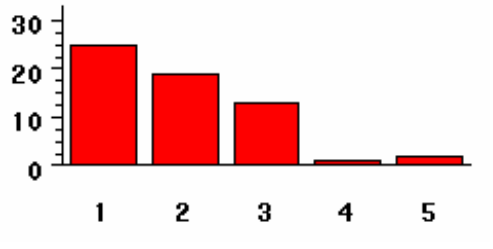
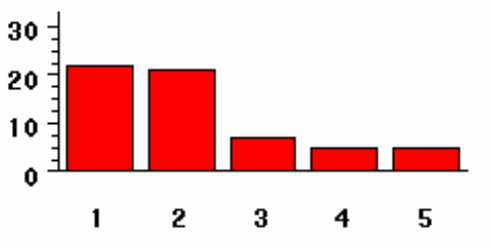
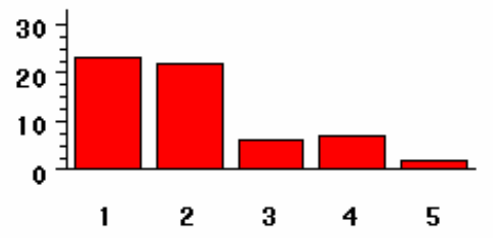
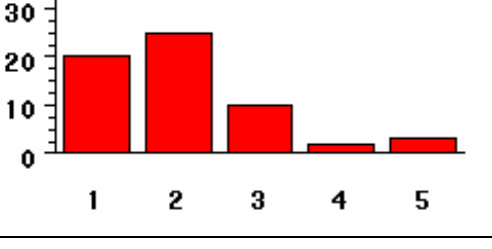
(Statements marked with "A" are alternative positions and statements marked with "D" are dominant positions in items used to portray the alternative-dominant paradigmatic position. Statements without marks are open questions in Group 3).

1	<p>More research should be multidisciplinary to facilitate broader perspectives on weed control</p> <p>"A"</p>	 <table border="1" data-bbox="611 913 1082 1144"> <thead> <tr> <th>Rating</th> <th>Frequency</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>10</td> </tr> <tr> <td>2</td> <td>10</td> </tr> <tr> <td>3</td> <td>30</td> </tr> <tr> <td>4</td> <td>5</td> </tr> <tr> <td>5</td> <td>8</td> </tr> </tbody> </table>	Rating	Frequency	1	10	2	10	3	30	4	5	5	8	<p>More research should go in depth to improve basic understanding of mechanisms related to weed control</p> <p>"D"</p>
Rating	Frequency														
1	10														
2	10														
3	30														
4	5														
5	8														
2	<p>More research should adapt theories and methods from basic disciplines in natural sciences</p> <p>"D"</p>	 <table border="1" data-bbox="611 1189 1082 1420"> <thead> <tr> <th>Rating</th> <th>Frequency</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>5</td> </tr> <tr> <td>2</td> <td>7</td> </tr> <tr> <td>3</td> <td>17</td> </tr> <tr> <td>4</td> <td>18</td> </tr> <tr> <td>5</td> <td>13</td> </tr> </tbody> </table>	Rating	Frequency	1	5	2	7	3	17	4	18	5	13	<p>More research should adapt systems approaches that include whole agro-ecosystem</p> <p>"A"</p>
Rating	Frequency														
1	5														
2	7														
3	17														
4	18														
5	13														
3	<p>Farmers' knowledge and attitudes are critical to progress in weed control</p> <p>"A"</p>	 <table border="1" data-bbox="611 1464 1082 1695"> <thead> <tr> <th>Rating</th> <th>Frequency</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>10</td> </tr> <tr> <td>2</td> <td>13</td> </tr> <tr> <td>3</td> <td>25</td> </tr> <tr> <td>4</td> <td>10</td> </tr> <tr> <td>5</td> <td>5</td> </tr> </tbody> </table>	Rating	Frequency	1	10	2	13	3	25	4	10	5	5	<p>Research is critical to progress in weed control</p> <p>"D"</p>
Rating	Frequency														
1	10														
2	13														
3	25														
4	10														
5	5														
4	<p>Researchers should aim to develop "product in a package" in order to provide the best option for farmers</p> <p>"D"</p>	 <table border="1" data-bbox="611 1740 1082 1971"> <thead> <tr> <th>Rating</th> <th>Frequency</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>2</td> </tr> <tr> <td>2</td> <td>4</td> </tr> <tr> <td>3</td> <td>8</td> </tr> <tr> <td>4</td> <td>27</td> </tr> <tr> <td>5</td> <td>23</td> </tr> </tbody> </table>	Rating	Frequency	1	2	2	4	3	8	4	27	5	23	<p>Researchers should emphasise the importance of evaluating series of alternative solutions in order to provide the best option for farmer's own choice</p> <p>"A"</p>
Rating	Frequency														
1	2														
2	4														
3	8														
4	27														
5	23														

5	<p>More research should be done in strictly controlled environments to make results more precise</p> <p>“D”</p>		<p>More research should be done on working farms to make results more realistic</p> <p>“A”</p>
6	<p>Future research priorities should be given to direct control methods (curative methods)</p>		<p>Future research priorities should be given to indirect control methods (preventive methods)</p>
7	<p>Future research priorities should be given to chemical weed control</p>		<p>Future research priorities should be given to non-chemical weed control</p>
8	<p>Future weed management practices in industrialised countries will mainly be based on physical and cultural methods</p>		<p>Future weed management practices in industrialised countries will mainly be based on herbicides and/or gene modified crops</p>
9	<p>Future use of physical and cultural weed control will expand within conventional agriculture</p>		<p>Future use of physical and cultural weed control will primarily be restricted to organic farming</p>
10	<p>Precision guided implements and robotic systems will revolutionize physical weed control within the next decade</p>		<p>Precision guided implements and robotic systems will only make limited contribution to physical weed control within the next decade</p>
11	<p>Weed research should include value-laden issues in the research process because they are important</p> <p>“A”</p>		<p>Weed research should demarcate itself from value-laden issues and stick to unbiased and impersonal issues</p> <p>“D”</p>

12	Weed research should strengthen focus on advanced technology like robotic systems and/or biotechnology	 <table border="1" data-bbox="619 232 1098 461"> <thead> <tr> <th>Rating</th> <th>Count</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>8</td> </tr> <tr> <td>2</td> <td>5</td> </tr> <tr> <td>3</td> <td>15</td> </tr> <tr> <td>4</td> <td>14</td> </tr> <tr> <td>5</td> <td>19</td> </tr> </tbody> </table>	Rating	Count	1	8	2	5	3	15	4	14	5	19	Weed research should strengthen focus on complex agro-ecosystem processes and interactions
Rating	Count														
1	8														
2	5														
3	15														
4	14														
5	19														
13	Holistic approaches should be integrated in weed research to an increasing extent “A”	 <table border="1" data-bbox="619 495 1098 723"> <thead> <tr> <th>Rating</th> <th>Count</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>15</td> </tr> <tr> <td>2</td> <td>25</td> </tr> <tr> <td>3</td> <td>12</td> </tr> <tr> <td>4</td> <td>5</td> </tr> <tr> <td>5</td> <td>5</td> </tr> </tbody> </table>	Rating	Count	1	15	2	25	3	12	4	5	5	5	Holism is a misused phrase without much relevance to weed research “D”
Rating	Count														
1	15														
2	25														
3	12														
4	5														
5	5														
14	Objectivity is a core value in weed research “D”	 <table border="1" data-bbox="619 768 1098 996"> <thead> <tr> <th>Rating</th> <th>Count</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>18</td> </tr> <tr> <td>2</td> <td>20</td> </tr> <tr> <td>3</td> <td>19</td> </tr> <tr> <td>4</td> <td>3</td> </tr> <tr> <td>5</td> <td>2</td> </tr> </tbody> </table>	Rating	Count	1	18	2	20	3	19	4	3	5	2	Objectivity is a misused phrase without much relevance to weed research “A”
Rating	Count														
1	18														
2	20														
3	19														
4	3														
5	2														
15	Good research produces knowledge which is useful in a scientific context “D”	 <table border="1" data-bbox="619 1025 1098 1254"> <thead> <tr> <th>Rating</th> <th>Count</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>5</td> </tr> <tr> <td>2</td> <td>9</td> </tr> <tr> <td>3</td> <td>33</td> </tr> <tr> <td>4</td> <td>9</td> </tr> <tr> <td>5</td> <td>7</td> </tr> </tbody> </table>	Rating	Count	1	5	2	9	3	33	4	9	5	7	Good research produces knowledge which is useful in a societal context “A”
Rating	Count														
1	5														
2	9														
3	33														
4	9														
5	7														
16	Research papers would generally be improved if research methods were emphasised in order to clarify how experiments were conducted and data analysed	 <table border="1" data-bbox="619 1294 1098 1523"> <thead> <tr> <th>Rating</th> <th>Count</th> </tr> </thead> <tbody> <tr> <td>2</td> <td>10</td> </tr> <tr> <td>3</td> <td>32</td> </tr> <tr> <td>4</td> <td>13</td> </tr> <tr> <td>5</td> <td>8</td> </tr> </tbody> </table>	Rating	Count	2	10	3	32	4	13	5	8	Research papers would generally be improved if it was emphasised how previous research had influenced the choice of question, interpretation of data and conclusion		
Rating	Count														
2	10														
3	32														
4	13														
5	8														
17	More reviews are needed to critically examine what has actually been achieved to decide what to do next	 <table border="1" data-bbox="619 1563 1098 1792"> <thead> <tr> <th>Rating</th> <th>Count</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>13</td> </tr> <tr> <td>2</td> <td>23</td> </tr> <tr> <td>3</td> <td>19</td> </tr> <tr> <td>4</td> <td>4</td> </tr> <tr> <td>5</td> <td>1</td> </tr> </tbody> </table>	Rating	Count	1	13	2	23	3	19	4	4	5	1	More experimental research is needed before it is worthwhile to make more reviews
Rating	Count														
1	13														
2	23														
3	19														
4	4														
5	1														

18	All papers published in Weed Research (all topics) are valuable because they contribute to scientific knowledge	<table border="1"> <thead> <tr> <th>Rating</th> <th>Count</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>5</td> </tr> <tr> <td>2</td> <td>20</td> </tr> <tr> <td>3</td> <td>22</td> </tr> <tr> <td>4</td> <td>15</td> </tr> <tr> <td>5</td> <td>5</td> </tr> </tbody> </table>	Rating	Count	1	5	2	20	3	22	4	15	5	5	Many papers published in Weed Research (all topics) are of limited value simply because they don't seem to make a difference
Rating	Count														
1	5														
2	20														
3	22														
4	15														
5	5														
19	Novelty is a crucial attribute in good weed research	<table border="1"> <thead> <tr> <th>Rating</th> <th>Count</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>8</td> </tr> <tr> <td>2</td> <td>13</td> </tr> <tr> <td>3</td> <td>21</td> </tr> <tr> <td>4</td> <td>15</td> </tr> <tr> <td>5</td> <td>8</td> </tr> </tbody> </table>	Rating	Count	1	8	2	13	3	21	4	15	5	8	Correctness is a crucial attribute in good weed research
Rating	Count														
1	8														
2	13														
3	21														
4	15														
5	8														
20	Meeting food needs with fewer and fewer farmers is a positive outcome of research and technological progress "D"	<table border="1"> <thead> <tr> <th>Rating</th> <th>Count</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>6</td> </tr> <tr> <td>2</td> <td>10</td> </tr> <tr> <td>3</td> <td>15</td> </tr> <tr> <td>4</td> <td>14</td> </tr> <tr> <td>5</td> <td>20</td> </tr> </tbody> </table>	Rating	Count	1	6	2	10	3	15	4	14	5	20	Meeting food needs with fewer and fewer farmers is a negative outcome of our free market system "A"
Rating	Count														
1	6														
2	10														
3	15														
4	14														
5	20														
21	Research should be better coordinated nationally and internationally to facilitate collaboration	<table border="1"> <thead> <tr> <th>Rating</th> <th>Count</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>23</td> </tr> <tr> <td>2</td> <td>28</td> </tr> <tr> <td>3</td> <td>8</td> </tr> <tr> <td>4</td> <td>5</td> </tr> </tbody> </table>	Rating	Count	1	23	2	28	3	8	4	5	Research is well coordinated, further coordination will impede competition between research environments		
Rating	Count														
1	23														
2	28														
3	8														
4	5														
22	Technology should be used to make farm labour more rewarding and enjoyable, but not to replace it "A"	<table border="1"> <thead> <tr> <th>Rating</th> <th>Count</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>18</td> </tr> <tr> <td>2</td> <td>23</td> </tr> <tr> <td>3</td> <td>9</td> </tr> <tr> <td>4</td> <td>7</td> </tr> <tr> <td>5</td> <td>8</td> </tr> </tbody> </table>	Rating	Count	1	18	2	23	3	9	4	7	5	8	Farm labour should be replaced whenever possible by more efficient machines and other technologies "D"
Rating	Count														
1	18														
2	23														
3	9														
4	7														
5	8														
23	Agricultural scientists and policy-makers should recognize that there are limits to what nature can provide and adjust their expectations accordingly "A"	<table border="1"> <thead> <tr> <th>Rating</th> <th>Count</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>24</td> </tr> <tr> <td>2</td> <td>20</td> </tr> <tr> <td>3</td> <td>10</td> </tr> <tr> <td>4</td> <td>8</td> </tr> <tr> <td>5</td> <td>3</td> </tr> </tbody> </table>	Rating	Count	1	24	2	20	3	10	4	8	5	3	Agricultural scientists and policy-makers should expand efforts to develop biotechnologies and other innovations in order to increase food supplies "D"
Rating	Count														
1	24														
2	20														
3	10														
4	8														
5	3														

24	<p>Good farming depends mainly on personal experience and knowledge of the land</p> <p>“A”</p>	 <table border="1"> <thead> <tr> <th>Category</th> <th>Value</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>10</td> </tr> <tr> <td>2</td> <td>22</td> </tr> <tr> <td>3</td> <td>22</td> </tr> <tr> <td>4</td> <td>11</td> </tr> </tbody> </table>	Category	Value	1	10	2	22	3	22	4	11	<p>Good farming depends mainly on applying the findings of modern agricultural science</p> <p>“D”</p>		
Category	Value														
1	10														
2	22														
3	22														
4	11														
25	<p>Farmers should use primarily natural fertilizers and production methods such as manure, crop rotations, compost and biological pest control</p> <p>“A”</p>	 <table border="1"> <thead> <tr> <th>Category</th> <th>Value</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>25</td> </tr> <tr> <td>2</td> <td>20</td> </tr> <tr> <td>3</td> <td>14</td> </tr> <tr> <td>4</td> <td>2</td> </tr> <tr> <td>5</td> <td>3</td> </tr> </tbody> </table>	Category	Value	1	25	2	20	3	14	4	2	5	3	<p>Farmers should use primarily synthetic fertilizers and pesticides in order to maintain adequate levels of production</p> <p>“D”</p>
Category	Value														
1	25														
2	20														
3	14														
4	2														
5	3														
26	<p>Modern agriculture is a major cause of ecological problems and must be greatly modified to become ecologically sound</p> <p>“A”</p>	 <table border="1"> <thead> <tr> <th>Category</th> <th>Value</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>23</td> </tr> <tr> <td>2</td> <td>22</td> </tr> <tr> <td>3</td> <td>8</td> </tr> <tr> <td>4</td> <td>6</td> </tr> <tr> <td>5</td> <td>6</td> </tr> </tbody> </table>	Category	Value	1	23	2	22	3	8	4	6	5	6	<p>Modern agriculture is a minor cause of ecological problems and needs to be only fine-tuned periodically in order to be ecologically sound</p> <p>“D”</p>
Category	Value														
1	23														
2	22														
3	8														
4	6														
5	6														
27	<p>The key to agriculture’s future success lies in learning to imitate natural ecosystems and farm in harmony with nature</p> <p>“A”</p>	 <table border="1"> <thead> <tr> <th>Category</th> <th>Value</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>24</td> </tr> <tr> <td>2</td> <td>23</td> </tr> <tr> <td>3</td> <td>7</td> </tr> <tr> <td>4</td> <td>8</td> </tr> <tr> <td>5</td> <td>3</td> </tr> </tbody> </table>	Category	Value	1	24	2	23	3	7	4	8	5	3	<p>The key to agriculture’s future success lies in the continued development of advanced technologies that will overcome nature’s limits</p> <p>“D”</p>
Category	Value														
1	24														
2	23														
3	7														
4	8														
5	3														
28	<p>Organic farming is a sustainable farming practice</p>	 <table border="1"> <thead> <tr> <th>Category</th> <th>Value</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>21</td> </tr> <tr> <td>2</td> <td>26</td> </tr> <tr> <td>3</td> <td>11</td> </tr> <tr> <td>4</td> <td>3</td> </tr> <tr> <td>5</td> <td>4</td> </tr> </tbody> </table>	Category	Value	1	21	2	26	3	11	4	3	5	4	<p>Organic farming is not a sustainable farming practice</p>
Category	Value														
1	21														
2	26														
3	11														
4	3														
5	4														

Personal information:

Male: Female:

My main research area(s) - please indicate percentage:

Mechanical weed control	Soil tillage	Thermal weed control	Preventive and cultural methods	Engineerin g	Herbicide technology	Weed biology	Other
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

E-mail address:

(Information given by individuals are kept confidential)

Comments:

I want an e-mail about the results of the inquiry Yes:

For further information please contact Jesper Rasmussen (jer@kvl.dk)

References

- BEUS CE & DUNLAP RE (1991). Measuring adherence to alternative vs. conventional agricultural paradigms: A proposed scale. *Rural Sociology*, **56**, 432-460.
- LOCKERETZ. W & ANDERSON MD (1993). *Agricultural Research Alternatives*. University of Nebraska Press, Lincoln, USA.
- PACKHAM R (2003). Concepts behind the Farming Systems Approach. In *The Australian Farming Systems Conference*, Toowoomba, Queensland, Australia, 7-11 September 2003, pp. 26-48.
- RASMUSSEN, J. & KALTOFT P (2003). Alternative versus conventional values and attitudes in higher agricultural education. *Biological Agriculture & Horticulture* **20**, 347-363.