ISSN 2175-6813

Revista Engenharia na Agricultura

V.28, p.78-88, 2020

Viçosa, MG, DEA/UFV - DOI: 10.13083/reveng.v28i.8438

# SYSTEMATIC BIBLIOGRAPHICAL REVIEW OF SCIENTIFIC PUBLICATIONS ON THE USE OF MILLET AND SORGHUM AS VEGETABLE COVER

Bruno César Góes[1], Willian Aparecido Leoti Zanetti[2], Renato Jaqueto Góes[3], Camila Pires Cremasco[4], Fernando Ferrari Putti[5] & Luís Roberto Almeira Gabriel Filho[6]

1 - Doutorando em Agronegócio e Desenvolvimento, Professor Univ. José do Rosário Vellano (UNIFENAS), Faculdade de Agronomia, Alfenas-MG
2 - Mestrando em Agronomia, Universidade Estadual Paulista (UNESP), Faculdade de Ciências Agronômicas, Botucatu-SP
3 - Doutor em Agronomia, Professor Universidade Federal do Mato Grosso do Sul (UFMS), Departamento de Agronomia, Chapadão do Sul-MS
4 - Doutora em Agronomia, Professora Universidade Estadual Paulista (UNESP), Faculdade de Ciências e Engenharia, Tupã-SP
5 - Doutor em Agronomia, Professor Universidade Estadual Paulista (UNESP), Faculdade de Ciências e Engenharia, Tupã-SP
6 - Doutor em Agronomia, Professor Universidade Estadual Paulista (UNESP), Faculdade de Ciências e Engenharia, Tupã-SP

**Keywords:**
Coverage Cultures
No-Tillage
SBR

**ABSTRACT**

The use of alternative systems seeking unsustainability in agricultural production in Brazil, has developed strongly with the use of No-Tillage System (NTS), therefore remodeling the production system. For the production efficiency, it is necessary to use suitable crops as plant cover, depending on the region where the no-tillage system will be set, in which sorghum and millet crops were very positive. Thus, the objective of the work is to perform a systematic literature review on papers approaching the subject with the use of sorghum and millet as a vegetative cover for subsequent no-tillage. It is possible to verify a concentration of the studies after the 2000 decade, in the Southeastern and Central-Western regions of Brazil.

**Palavras-chave**:
Culturas de Cobertura
Plantio Direto
RBS

**REVISÃO BIBLIOGRÁFICA SISTEMÁTICA DAS PUBLICAÇÕES CIENTÍFICAS ACERCA DA UTLIZAÇÃO DE MILHETO E SORGO COMO COBERTURA VEGETAL**

**RESUMO**

A utilização de sistemas alternativos procurando a sustentabilidade na produção agrícola no Brasil, desenvolveu-se fortemente com a utilização do Sistema Plantio Direto (SPD), remodelando o sistema de produção. Para eficiência da produção, é necessária a utilização de culturas adequadas como cobertura vegetal, a depender da região a ser implantada o sistema plantio direto, tendo como muito positiva as culturas de sorgo e milheto. Assim, o objetivo do trabalho foi realizar uma revisão bibliográfica sistemática sobre artigos que estudaram o tema com a utilização do sorgo e milheto como cobertura vegetal para posterior plantio direto. Sendo possível verificar a concentração dos estudos após a década de 2000, nas regiões Sudeste e Centro-Oeste do Brasil.



Recebido para publicação em 19/05/2019 • Aprovado em 11/09/2019 • Publicado em 04/02/2020

## INTRODUCTION

Agriculture is one of the oldest food production activities performed by the man. It is associated with the development of the first civilizations. Furthermore, its activities have been technologically intensified over the years due to the global food demand caused by the population increase over the years (BUAINAIN, et al., 2016).

However, over the years, the relationship between the cropped area for food production and population growth has been reduced, which makes it necessary to use precise measures for global food service, since estimates indicate that, to provide enough food to meet the world's demand until 2050, food production needs to be increased by around 60% to 110% (RAY et al., 2013).

Due to the increase in population, land use exploitation was intensified through the intensive soil management practices, the adoption of monoculture in addition to the large use of pesticides to ensure greater production of food (FELEMA, et al., 2013 ). Thus, the use of agrochemicals and new technologies is expanding, which aim to provide better soil management, assuring the quality and productivity of crops combined with the saving of natural resources such as soil and water for irrigation (PUTTI et al., 2014; KLAR, et al., 2015; PUTTI et al., 2017; OLIVEIRA, et al., 2018).

The development of modern agriculture began in the mid-1950s with the Green Revolution, which has been spreading on a larger scale since 1970, with the need for food production after the war, with the insertion of technological innovations, use of varieties of high-yield seeds with the addition of genetically modified plants, management practices and application of pesticides in the production (SILVA et al*.,* 2018; SANTOS; JOHN, 2018).

However, changes in attitudes regarding the use of those techniques and the use of systems that can be more sustainable have intensified over the years, guaranteeing na efficient and nutritious production and in a way that does not harm the environment intensely, as well as studies based on the economy of natural resources, for example the use of water for irrigation (VIAIS NETO et al., 2019a; GERHARDT, 2016; PEREIRA, et al., 2017).

Allowing the insertion and diffusion of Conservation Agriculture (CA), which developed because of those obstacles, it is sought a production that will guarantee the safety and preservation of the environment and the soil, minimally changing the structure and biodiversity, with gains in food productivity, in addition to generating savings in the use of natural resources (VIAS NETO et al., 2019b; PUTTI et al., 2017; BARBITO; NYARUWATA, 2015).

Thus, the No-Tillage Planting System (NTS) is found, which consists of a cultivation technique, in which, one of the requirements is that the planting is carried out without the conventional use of preparation (plowing and harrowing), that is, the soil is not disturbed, and the plant cover of the crop remains and straw from the previous crop is maintained, in addition to resulting in a system with a lower degree of impact on the environment and stimulating the restoration of biodiversity in the soil. In that system, less water is used for irrigation, as there is a lower incidence of evapotranspiration (PUTTI et al., 2015; FAVARATO et al., 2016; MILAGRES et al., 2018).

However, the success of a cover crop is associated with its high biomass and/or dry matter yield, directly related to the level of C/ N (carbon / nitrogen) concentration, in addition to the edaphoclimatic factors typical of each region ( SILVA FILHO et al., 2018).

Thus, millet and sorghum crops are considered excellent cover crops, adapted for the Central-West region, as in addition to the high C/N concentration, they have a deep root system for greater water uptake in dry periods, typical of the *Caatinga* (Brazilian dry forest) (GOES, 2016; SEBEN JUNIOR et al., 2016). Thus, the objective of this work was to carry out a systematic review

of the literature, about the works related to the No-Tillage System using the vegetable coverings of millet and sorghum.

## MATERIAL AND METHODS

This work used the methodology proposed by Conforto et al., the RBS Roadmap as a search script for the Systematic Bibliographic Review (2011), which consists of a sequence of three phases: Input, in which the information to be processed to search for scientific articles is defined, as well as other bibliographies indicated by the specialists; Processing, which will make the whole process of searching for input information, which in turn will cause the Output, which will allow for the synthesis of results, reports, among others (LEVY; ELLIS, 2006; CONFORTO et al., 2011).

List of the steps performed in the RBS *Roadmap* construction process (Table 1).

The details of the information contained in each stage of the RBS implementation will be described throughout the work, as we can see below (Table 2), the information related to the first stage of the process.

During the realization of the first SBR step, the research Problem was defined, as well as the Objective of the work. It is also stressed for the inclusion of bibliographies recommended by experts, as defined in the "Primary Sources" in addition to the search strings in the database selected for the research together with the criteria adopted for the selection of scientific papers.

Information processing defined above, is described according to the input of different strings, as it is observed in Table 3.

**Table 1: Construction model for Systematic Bibliographic Review** (SBR).

| 1 – Input | 2 – Processing | 3 – Output |
|---|---|---|
| 1.1 Problem | 2.1 Search conduction | 3.1 Registration |
| 1.2 Objective | 2.2 Result analysis | 3.2 Result synthesis |
| 1.3 Primary Sources | | |
| 1.4 Search *Strings* | | |
| 1.5 inclusion criteria | | |

Source: Adapted from Conforto et al. (2011).

**Table 2:** Information input for *Roadmap* processing (RBS).

| | |
|---|---|
| 1.1 Problem | How are scientific publications configured in relation to the use of sorghum and millet as vegetable cover for the subsequent no-tillage crop? |
| 1.2 Objective | To conduct a Systematic Bibliographic Review (RBS) of scientific papers on the use of sorghum and millet as vegetable covers for subsequent no-tillage crops. |
| 1.3 primary sources | a) Indication by the Advisor.<br>b) SCIELO Indexer. |
| 1.4 Search *Strings* | *"sorghum OR Sorgo", "millet OR milheto", "vegetal cover OR cobertura vegetal", "vegetable cover", "cover plants OR plantas de coberturas", "no-tillage OR plantio direto", "direct planting".* |
| 1.5 Inclusion criteria | a) Only papers..<br>b) Publications with emphasis on the use of sorghum and millet as vegetation cover. |

Source: Elaborated by the authors.

**Table 3:** Search strings information processing (SCIELO).

| *Search Strings* | All indices | Date |
|---|---|---|
| *"Sorghum" OR "Sorgo"* | 1,351 | August 21 2017 |
| *"Millet" OR "milheto"* | 537 | |
| *(("Sorgo" OR "sorghum") AND ("millet" OR "milheto"))* | 120 | |
| *(("sorgo" OR "sorghum") AND ("millet" OR "milheto")) AND (("Vegetal cover" OR "vegetable cover" OR "cover plants" OR "plantas de coberturas" OR "cobertura vegetal"))* | 13 | |
| *(("Sorghum" OR "Sorgo") AND ("Millet" OR "milheto")) AND (("Vegetal Cover" OR "vegetable cover" OR "cover plants" OR "plantas de coberturas" OR "cobertura vegetal" OR "rotação de culturas" OR "rotação de cultura") OR ("no-tillage" OR "direct planting" OR "plantio direto"))* | 61 | |

Source: Elaborated by the authors.

During the processing phase, the search was performed using keywords related to the strings topic. Firstly, a search was made for scientific works containing strings (*"*Sorgo*"* OR "Sorghum"), covering works in Portuguese and English, obtaining a total of 1,351 scientific papers in the SICELO database.

Likewise, it was made for strings *("milheto" OR "millet")*, with the equivalent of 537 works.

The objective is to search for topics related to the use of millet and sorghum as a vegetation cover, so the search proceeded through publications referring to the use of millet and sorghum, simultaneously, defined as search strings: ((*"sorgo"* OR *"Sorghum"*) AND (*"millet"* OR *"milheto"*)), resulting in 120 publications in SCIELO.

As a result, the strings defined in the previous paragraph were combined with publications related to vegetable coverings, characterized as search strings: AND ((*"Vegetable cover"* OR *"vegetable cover"* OR *"cover plants"* OR "plantas de coberturas" *OR* "cobertura vegetal")), resulting in a total of only 13 publications. Due to the small number of works to be researched, a new search was carried out in the database, covering publications that deal with topics on no-tillage, resulting in the search string: ((*"Sorghum" OR* "Sorgo") *AND* ("*Millet*" *OR* "milheto")) *AND* (("*Vegetal Cover*" *OR* "*vegetable cover*" *OR* "*cover plants*" *OR* "plantas de coberturas" *OR* "cobertura vegetal" *OR* "crop rotation" *OR* "rotação de cultura") *OR* ("*no-tillage*" *OR* "*direct planting*" *OR* "plantio direto")), aiming to cover the largest number of publications related to the research objective, with a total of 61 works, distributed over the years as illustrated in Figure 1.

Following the previous step, search filters are started, in which, due to the small number of papers published over the years, all publications resulting from the search were taken into account, totaling 61 documents, to start the filters search results as shown in Table 4.

According to Table 4, after the filter in the SCIELO database, to return only scientific articles, there were 61 articles; all of which are published in the field of agricultural sciences, with 60 articles published in Brazilian journals.

After the return of the 60 articles, with the filtering available through the database, the reading of the titles and abstract begins, according to the pre-established exclusion criteria in accordance with the objective of the study.

Table 5 shows the volume of publications after performing the post-reading filters.

Over the process of reading the titles and abstracts of the 60 papers selected by the search filters, a total of 22 articles were excluded according to pre-defined exclusion criteria, out of which five dealt with topics related to animal nutrition; 10 that approached topics related to the control of weeds and herbicides, three on the crop-livestock system and four papers that had an emphasis on the irrigation system.

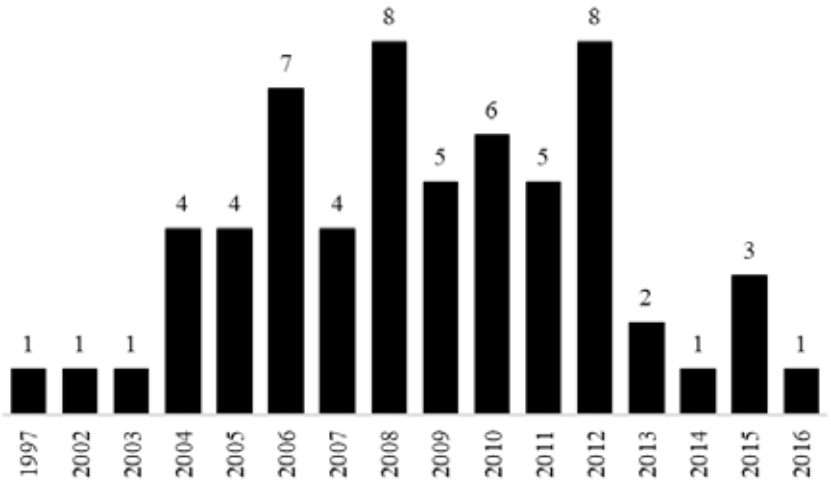


**Figure 1:** Distribution of the publications over the years on SCIELO database.

**Table 4:** SCIELO publication volume after search filter application.

| Search filters | After filter |
|---|---|
| Papers | 61 |
| Agriculture Science | 61 |
| Brazil | 60 |

Source: Elaborated by the authors.

**Table 5:** Volume of papers after the Reading phase and application of exclusion criteria.

| Total of publications 60 | | | |
|---|---|---|---|
| **Phases** | | **After filter** | **Inclusion and exclusion criteria *** |
| 1 | Title and abstract reading | 38 | a) Animal nutrition (5)<br>b) Weed/herbicides control (10)<br>c) Crop /livestock system (3)<br>d) Emphasis on irrigation (4) |
| 2 | Reading of the introduction and conclusions | 16 | a) Animal nutrition (1)<br>b) Weed/herbicides control (2)<br>c) Crop /livestock system (4)<br>d) Emphasis on irrigation (3)<br>e) Soil physical aspects (9)<br>f) Yield agronomic analysis (3) |
| 3 | Complete reading | 16 | a) Soil chemical attributes analysis using millet and sorghum as vegetal cover * |

Source: Elaborated by the authors.

Once 38 articles were selected using the exclusion criteria, the introduction and conclusion were read in order to confirm the previous criteria. Hence, 21 scientific papers were removed from the selection of 38 articles, according to the criteria, which was 1 due to the focus on animal nutrition; 2 to weed control; 4 to the crop-livestock system; 3 with emphasis on the irrigation system, in addition to nine papers on the physical characteristics of the soil and three referring to agronomic analysis of productivity.

Thus, there were 16 scientific papers left for the complete reading process, which was characterized in the final number of papers related to the analysis of the chemical attributes of the soil using millet and sorghum as a vegetation cover, which will be made the analysis of results about the publications on the purpose of the work.

**Table 6:** List of the papers selected for the analysis.

| | **Selected papers** |
|---|---|
| 1. | MARCELO, A. V.; CORÁ, J. E.; FERNANDES, C. Crop sequences in no-tillage system: II - dry matter decomposition and nutrient release in the second growing season. **Revista Brasileira de Ciência do Solo**, v. 36, n. 5, p. 1568-1582, 2012. |
| 2. | MARCELO, A. V.; CORÁ, J. E.; FERNANDES, C. Crop sequences in no-tillage system: I - Dry matter production and nutrient accumulation. Revista Brasileira de Ciência do Solo, v. 36, n. 5, p. 1553-1567, 2012. |
| 3. | SIMIDU, H. M.; SÁ, M. E.; SOUZA, L. C. D.; ABRANTES, F. L.; SILVA, M. P.; ARF, O. Effect of green manure and sowing date on the productivity of bean no-tillage in the Cerrado region.. Acta Scientiarum Agronomy, v. 32, n. 2, p. 309-315, 2010. |
| 4. | CALVO, C. L.; FOLONI, J. S. S.; BRANCALIÃO, S. R. Phytomas yield and C/N relation of the single crops and intercrops of pigeon pea, sorghum and pear millet in three cut management times. Bragantia, v. 69, n. 1, p. 77-86. 2010. |
| 5. | MARCELO, A. V.; CORÁ, J. E.; FERNANDES, C.; MARTINS, M. R.; JORGE, R. F. Crop sequences in no-tillage system: effects on soil fertility and soybean, maize and rice yield. Revista Brasileira de Ciência do Solo, v. 33, n. 2, p. 417-428, 2009. |
| 6. | LIMA, E. V.; CRUSCIOL, C. A. C.; CAVARIANI, C.; NAKAGAWA, J. Agronomic traits, yield and physiological quality of "safrinha" (off-season) soybean under no till as a function of plant cover and surface liming. Revista Brasileira de Sementes, v. 31, n. 1, p. 69-80, 2009. |
| 7. | PAVINATO, P. S.; MERLIN, A.; ROSOLEM, C. A. Organic compounds from plant extracts and their effect on soil phosphorus availability. Pesquisa Agropecuária Brasileira, v. 43, n. 10, p. 1379-1388, 2008. |
| 8. | TORRES, J. L. R.; PEREIRA, M. G.; FABIAN, A. J. Cover crops biomass production and its residues mineralization in a Brazilian no-till Oxisol. Pesquisa Agropecuária Brasileira, v. 43, n. 3, p. 421-428, 2008. |
| 9. | CAZETTA, D. A.; ARF, O.; BUZETTI, S.; SÁ, M. E.; RODRIGUES, R. A. F. Performance of upland rice to the nitrogen rates after different cover crops in no-till system. Bragantia, v. 67, n. 2, p. 471-479, 2008. |
| 10. | BRAZ, A. J. B. P.; SILVEIRA, P. M.; KLIEMANN, H. J.; ZIMMERMANN, F. J. P. Nitrogen fertilization of wheat grown under no-tillage after different cover crops. Ciência e Agrotecnologia, v. 30, n. 2, p. 193-198, 2006. |
| 11. | TORRES, J. L. R.; PEREIRA, M. G.; ANDRIOLI, I.; POLIDORO, J. C.; FABIAN, A. J. Cover crops residue decomposition and nitrogen release in a cerrado soil. Revista Brasileira de Ciência do Solo, v. 29, n. 4, p. 609-618, 2005. |
| 12. | SILVEIRA, P. M.; BRAZ, A. J. B. P.; KLIEMANN, H. J.; ZIMMERMANN, F. J. P. Nitrogen fertilization of common bean grown under no-tillage system after several cover crops. Pesquisa Agropecuária Brasileira, v. 40, n. 4, p. 377-381, 2005. |
| 13. | CORRÊA, J. C.; MAUAD, M.; ROSOLEM, C. A. Phosphorus in soil and soybean growth as affected by phosphate fertilization and cover crop residues. Pesquisa Agropecuária Brasileira, v. 39, n. 12, p. 1231-1237, 2004. |
| 14. | BAYER, C.; MARTIN NETO, L.; MIELNICZUK, J.; PAVINATO, A. Carbon storage in labile fractions of soil organic matter in a tropical no-tillage Oxisol. Pesquisa Agropecuária Brasileira, v. 39, n. 7, p. 677-683, 2004. |
| 15. | BORDIN, L.; FARINELLI, R.; PENARIOL, F. G.; FORNASIERI FILHO, D. DOUBLE CROP - COMMOM BEAN WITH UPLAND RICE, SUBMITTED TO RATES OF NITROGEN FERTILIZATION AFTER GREEN COVER UNDER NO-TILLAGE SYSTEM. Bragantia, v. 62, n. 3, p. 417-428, 2003. |
| 16. | OLIVEIRA, T. K.; CARVALHO, G. J.; MORAES, R. N. S. Cover crops and their effects on bean plant in no-tillage system. Pesquisa Agropecuária Brasileira, v. 37, n. 8, p. 1079-1087, 2002. |

Source: Elaborated by the authors.

Thus, the selection of the 16 articles concludes the information processing phase, then, the third stage of the work starts with the analysis of the results.

## RESULTS AND DISCUSSION

Following the final selection of the 16 articles, the analysis shown in the third phase of the SBR Roadmap process was carried out.

Figure 2 shows the overview of the publications over time.

The year 2002 is the starting point of the publications as the no-tillage system is a recent technique used in agriculture, which has had an increase in the study on the topic over the years with two publications in 2004, 2005, 2009, 2010 and 2012, three publications in 2008, and no papers in 2007 and 2011.

Thus, the regions where the studies on the use of sorghum and millet as vegetation cover were carried out showed a greater incidence in the Southeast region, with 11 publications and five publications in the Central-West region as an experimental area, showing satisfactory results in relation to dry matter yield and nutrient accumulation, as it can be seen in the graph below.

Of the 69% representation of the Southeast region, three experiments were carried out in the State of Minas Gerais, and eight studies in the State of São Paulo; nevertheless, in the Central-West region, three were in the State of Mato Grosso do Sul and two in Goiás, the ones representing 31% of the region where the experiment was carried out.

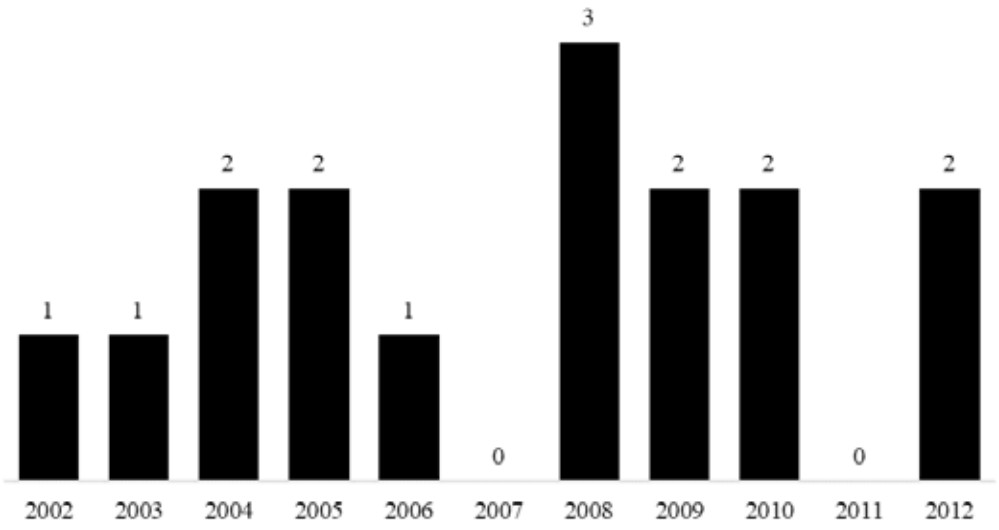


**Figure 2.** Volume of publications from 2002 to 2012.

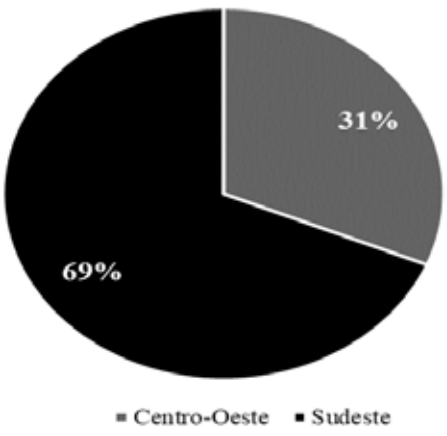


**Figure 3.** Regional distribution of the scientific experiments

Regarding the published journals, their analyses was made regarding the *Qualis* of the journals in the area of agricultural sciences, Table 7.

It can be observed the volume of publications in journals above B1, with nine articles submitted and six in journals classified with A2 *Qualis* and only 1 without *Qualis*, which characterizes publications with scientific impact value.

In general, the articles selected for analysis are classified in Table 8, below with information from the published journal, *Qualis* and number of citations of the paper in scientific papers.

**Table 7.** Number of publications, *Qualis* of the journals in the 2013-2016 four-year period.

| Journal | Publications | *Qualis* |
|---|---|---|
| Revista Brasileira de Ciência do Solo | 4 | A2 |
| Acta Scientiarum. Agronomy | 1 | A2 |
| Bragantia | 3 | B1 |
| Ciência e Agrotecnologia | 1 | A2 |
| Revista Brasileira de Sementes | 1 | - |
| Pesquisa Agropecuária Brasileira | 6 | B1 |

Source: Elaborated by the authors.

**Table 8.** Description of the papers selected for the analysis.

| Authors | Paper | Local | Journal | *Qualis* | Citations |
|---|---|---|---|---|---|
| MARCELO, A. V.; CORÁ, J. E.; FERNANDES, C. (2012) | *Crop sequences in no-tillage system: II - dry matter decomposition and nutrient release in the second growing season.* | Jaboticabal SP | Revista Brasileira de Ciência do Solo | A2 | 16 |
| MARCELO, A. V.; CORÁ, J. E.; FERNANDES, C. (2012) | *Crop sequences in no-tillage system: I - dry matter production and nutrient accumulation* | Jaboticabal SP | Revista Brasileira de Ciência do Solo | A2 | 11 |
| SIMIDU et al. (2010) | *Effect of green manure and sowing date on the productivity of bean no-tillage in the Cerrado region* | Selvíria MS | Acta Scientiarum. Agronomy | A2 | 13 |
| CALVO, C. L. et al. (2010) | *PHYTOMASS YIELD AND C/N RELATION OF SINGLE CROPS AND INTERCROPS OF PEGEON PEA, SORGHUM AND PEAR MILLET IN THREE CUT MANAGEMENT TIMES* | Presidente Prudente SP | Bragantia | B1 | 35 |
| MARCELO, A. V. et al. (2009) | *CROP SEQUENCES IN NO-TILLAGE SYSTEM: I - DRY MATTER PRODUCTION AND NUTRIENT ACCUMULATION* | Jaboticabal SP | Revista Brasileira de Ciência do Solo | A2 | 26 |
| LIMA, E. V. et al. (2009) | *Agronomic traits, yield and physiological quality of "safrinha" (off-season) soybean under no till as a function of plant cover and surface liming* | Botucatu SP | Revista Brasileira de Sementes | SQ | 14 |
| PAVINATO, P. S. et al. (2008) | *Organic compounds from plant extracts and their effect on soil phosphorus availability* | Botucatu SP | Pesquisa Agropecuária Brasileira | B1 | 1 |

| | | | | | |
|---|---|---|---|---|---|
| TORRES, J. L. R. et al. (2008) | *Cover crops biomass production and its residues mineralization in a Brazilian no-till Oxisol* | Uberaba MG | Pesquisa Agropecuária Brasileira | B1 | 176 |
| CAZETTA, D. A. et al. (2008) | *Performance of upland rice to the nitrogen rates after different cover crops in no-till system* | Selvíria MS | Bragantia | B1 | 27 |
| BRAZ, A. J. B. P. et al. (2006) | *Nitrogen fertilization of wheat grown under no-tillage after different cover crops* | Santo Antônio de Goiás GO | Ciência e Agrotecnologia | A2 | 42 |
| TORRES, J. L. R. et al. (2005) | *Cover crops residue decomposition and nitrogen release in a cerrado soil.* | Uberaba MG | Revista Brasileira de Ciência do Solo | A2 | 175 |
| SILVEIRA, P. M. et al. (2005) | *Nitrogen fertilization of common bean grown under no-tillage system after several cover crops* | Santo Antônio de Goiás GO | Pesquisa Agropecuária Brasileira | B1 | 68 |
| CORRÊA, J. C. et al. (2004) | *Phosphorus in soil and soybean growth as affected by phosphate fertilization and cover crop residues.* | Botucatu SP | Pesquisa Agropecuária Brasileira | B1 | 75 |
| BAYER, C. et al. (2004) | *Carbon storage in labile fractions of soil organic matter in a tropical no-tillage Oxisol* | Costa Rica MS | Pesquisa Agropecuária Brasileira | B1 | 195 |
| BORDIN, L. et al. (2003) | *Double crop - commom bean with upland rice, submitted to rates of nitrogen fertilization after green cover under no-tillage system* | Jaboticabal SP | Bragantia | B1 | 78 |
| OLIVEIRA, T. K. et al. (2002) | *Cover crops and their effects on bean plant in no-tillage system.* | Lavras MG | Pesquisa Agropecuária Brasileira | B1 | 203 |

Source: Elaborated by the authors.

Thus, publications on the use of millet and sorghum as vegetable coverings for later no-tillage crops are configured.

## CONCLUSIONS

- Based on publications in specialized journals referring to the use of the No-Tillage Planting System using plant coverings, millet and sorghum crops, the highest concentration of papers is observed between 2002 and 2012, since it is considered a recent activity in agriculture, with its experimental study in the Brazilian southeastern and central-western regions, obtaining publications in journals with scientific value, with A2 and B1 Qualis, in addition to the high number of citations of the papers, proving to be scientifically important for the area of agricultural sciences.

## ACKNOWLEDGEMENTS

This work was supported by the National Council for Scientific and Technological Development (CNPq) (grant number 303923/2018-0) for the research productivity grant granted to the penultimate author

## REFERENCES

BARBITO, A.; NYARUWATA, L.T. A agricultura de conservação e a sua sustentabilidade social. **Revista Electrónica de Investigação e Desenvolvimento**, n.4, 2015.

BUAINAIN, A.M.; GARCIA, J.R.; VIEIRA, P.A. O desafio alimentar no século XXI. **Estudos Sociedade e Agricultura**, v.24, n.2, p.497-522, 2016.

CONFORTO, E.C.; AMARAL, D.C.; SILVA, S.L. Roteiro para revisão bibliográfica sistemática : aplicação no desenvolvimento de produtos e gerenciamento de projetos. **8° Congresso Brasileiro de Gestão de Desenvolviemnto de Produto - CNGDP 2011**, v.8, p.1-12, 2011.

DA SILVA, S.A.; BALESTRIN, N.L.; BRANDENBURG, A.A agroecologia como um projeto em construção no movimento dos trabalhadores rurais Sem Terra – MST. **Revista GeoPantanal**, n.24, p.85-98, 2018.

FALEMA, J.; RAIHER, A.P.; FERREIRA, C.R. Agropecuária brasileira: desempenho regional e determinantes de produtividade. **Revista de Economia Sociologia Rural**, v.51 n.3, 2013.

FAVARATO, L.F.; SOUZA, J.L.; GALVÃO, J.C.C.; SOUZA, C.M.; GUARCONI, R.C.; BALBINO, J.M.S. Crescimento e produtividade do milho-verde sobre diferentes coberturas de solo no sistema plantio direto orgânico. **Bragantia**, Campinas, v.75, n.4, p.97-506, 2016.

GERHARDT, M. Uma história ambiental da modernização da agricultura: o norte do Rio Grande do Sul. História: **Debates e Tendências**, v.16, n.1, p.166-180, 2016.

GOES, R.J. **Doses de nitrogênio em coberturas vegetais e molibdênio foliar na soja em sucessão**. 2016. 77f. Tese (Doutorado) – Curso de Agronomia, Sistema de Produção, Universidade Estadual Paulista, Ilha Solteira, 2016.

KLAR, A.E.; PUTTI, F.F.; GABRIEL FILHO, L.R.A.; SILVA JUNIOR, J.F.; CREMASCO, C.P. The effects of different irrigation depths on radish crops. **Irriga**. v.1, p.150-159, 2015.

LEVY, Y.; ELLIS, T.J.A systems approach to conduct an effective literature review in support of information systems research. **Informing Science Journal**, v.9, p.181-211, 2006.

MILAGRES, R.S; MACHADO, T.A.; VIEIRA, L.B; FERNANDES, H.C. Avaliação dos atributos físicos do solo em áreas inclinadas com sistema de plantio. **Ciência Agrícola**, v.16, n.3, p.57-63, 2018.

OLIVEIRA, J.L.S.; LIMA, A.C.B. MININI, D.; SILVA, E. Usos, efeitos e potencial tóxico dos agrotóxicos na qualidade do solo. **AGRARIAN ACADEMY, Centro Científico Conhecer**, v.5, n.9; p.454-467, 2018.

PEREIRA, A.L.; GABRIEL, F.A.; SOUZA, R.M. Reflexões sobre a educação do campoe a Revolução Verde. **Revista Educação Online**, n.26, p.66-79, 2017.

PUTTI, F.F.; GABRIEL FILHO, L.R.A.; CREMASCO, C.P.; BONINI NETO, A.; BONINI, C.S.B.; REIS R.A.A Fuzzy mathematical model to estimate the effects of global warming on the vitality of Laelia purpurata orchids. **Mathematical Biosciences**. v.288, p.124-129, 2017.

PUTTI, F.F.; GABRIEL FILHO, L.R.A.; KLAR, A.E.; SILVA JUNIOR, J.F.; LUDWIG, R.; CREMASCO, C.P. Response of lettuce crop to magnetically treated irrigation water and different irrigation depths. **African Journal of Agricultural Research**, v.10, p.2300-2308, 2015.

PUTTI, F.F.; GABRIEL FILHO, L.R.A.; SILVA, A.O.; LUDWIG, R.; CREMASCO, C.P. Fuzzy logic to evaluate vitality of Catasetum Fimbiratum species (Orchidacea). **Irriga**. v.19, n.3, p.405-413, 2014.

PUTTI, F.F.; KUMMER, A.C.B.; GRASSI FILHO, H.; GABRIEL FILHO, L.R.A.; CREMASCO, C.P. Fuzzy modeling on wheat productivity under different doses of sludge and sewage effluent. **Engenharia Agricola**, v.37, p.1103-1115, 2017.

RAY, D.K.; MUELLER, N.D.; WEST, P.C.; FOLEY, J.A. Yield trends are insufficient to double global crop production by 2050. **PloS One,** San Francisco, v.8, n.6, p.1-8, 2013.

SANTOS, C.S.; JOHN, N.S. O desenvolvimento rural e a agroecologia: uma alternative para

sustentabilidade ambiental. **Brazilian Journal of Development**, v.4, n.6, p.3053-3063, 2018.

SEBEN JUNIOR, G.F.; CORA, J.E.; LAL, R. Qualidade física de um Latossolo sob Plantio Direto submetido a diferentes sistemas de cultivo. **Pesquisa Agropecuária Brasileira**. Brasília, v.51, n.9, p.1568-1574, 2016.

SILVA FILHO, J.L.; BORIN, A.L.D.C.; FERREIRA, A.C.B. Decomposição de matéria seca de plantas de cobertura na semeadura direta do algodoeiro. **Revista Caatinga**, Mossoró, v.31, n.2, p.264-270, 2018.

VIAIS NETO, D.S.; CREMASCO, C.P.; BORDIN, D.; PUTTI, F. F.; SILVA JUNIOR, J.F.; GABRIEL FILHO, L.R.A. Fuzzy modeling of the effects of irrigation and water salinity in harvest point of tomato crop. Part I: Description of the method. **Engenharia Agrícola**: Jaboticabal, v.39, p.294-304, 2019a.

VIAIS NETO, D.S.; CREMASCO, C.P.; BORDIN, D.; PUTTI, F.F.; SILVA JUNIOR, J.F.; GABRIEL FILHO, L.R.A. Fuzzy modeling of the effects of irrigation and water salinity in harvest point of tomato crop. Part II: Application and interpretation. **Engenharia Agrícola**: Jaboticabal, v.39, p.305-314, 2019b.