IJIREEICE ISSN (O) 2321-2004, ISSN (P) 2321-5526

International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering

ISO 3297:2007 Certified ⁜ Impact Factor 8.021 ⁜ Peer-reviewed / Refereed journal ⁜ Vol. 11, Issue 7, July 2023

DOI: 10.17148/IJIREEICE.2023.11711

Review on "Design and Development of an Agricultural Spray Nozzle with Adjustable Flow and Rotating Mechanism"

Bhaskar A Harikant[1], Gnanesh B S[1], Swaroop G[3]*, Mohan Kumar[4]

Department of Mechanical Engineering, Mangalore Institute of Technology & Engineering, Moodabidri, D.K -574225, Affiliated to VTU, Belagavi

*Corresponding Author: swaroop@mite.ac.in

Abstract: This comprehensive review paper presents an in-depth analysis of adjustable flow and rotating agricultural spray nozzles, focusing on their potential to enhance spray efficiency in agricultural applications. By reviewing ten selected journal papers, this study provides valuable insights into the design considerations, performance evaluation, and benefits of these innovative spray nozzle designs. The findings underscore the significance of adjustable flow control and rotating spray motions in achieving precise liquid application, optimizing resource utilization, and maximizing crop coverage.

Keywords: Agricultural nozzle, Swirling spray pattern, Uniform coverage, Fluid dynamics, Precision spraying, Spray efficiency

1.INTRODUCTION:

Efficient and precise agricultural spraying plays a crucial role in ensuring optimal crop protection and maximizing yields. Conventional spray nozzles often face challenges in achieving uniform spray distribution and minimizing off-target drift. Therefore, there is a need for innovative spray nozzle designs that offer adjustable flow control and rotating spray motions. This section establishes the significance of this review by highlighting the importance of improving spray efficiency in agricultural practices. Additionally, it outlines the objectives and structure of the paper.

By introducing these advanced features, these nozzle designs can significantly enhance spray efficiency. This section emphasizes the significance of this review in addressing the limitations of conventional spray nozzles and outlines the objectives of exploring adjustable flow and rotating spray nozzle technologies.

To enhance the visual appeal and provide a clear representation of conventional spray nozzles, it is recommended to include a relevant image depicting traditional spray nozzles and highlighting the specific challenges they face in achieving uniform spray distribution and minimizing off-target drift. This visual aid will effectively reinforce the need for innovative spray nozzle designs and capture the readers' attention.

Fig 0.1

IJIREEICE ISSN (O) 2321-2004, ISSN (P) 2321-5526

International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering

ISO 3297:2007 Certified ⁜ Impact Factor 8.021 ⁜ Peer-reviewed / Refereed journal ⁜ Vol. 11, Issue 7, July 2023

DOI: 10.17148/IJIREEICE.2023.11711

2. Adjustable Flow Nozzles: Adjustable flow nozzles provide the capability to control the liquid flow rate during spraying operations. This section discusses various aspects of adjustable flow nozzles based on findings from the reviewed papers, including Alidoost Dafsari et al. (2021) and Li et al. (2023). It explores the design principles, flow control mechanisms, and advantages of adjustable flow nozzles. To enhance the visual appeal and understanding, this section can include a schematic diagram illustrating the internal components and flow control mechanisms of adjustable flow nozzles.

3. Rotating Spray Nozzles: Rotating spray nozzles introduce rotational motion to the spray pattern, resulting in enhanced coverage and penetration into dense crop canopies. This section presents the key findings from papers such as Siebald et al. (2020) and Torrent et al. (2019) that focus on the benefits of rotating spray motions. It discusses various rotational mechanisms employed in spray nozzle designs, including swivel joints, rotating disks, and internal vane systems. To aid in comprehension, this sectioncan include a visual representation, such as a diagram or photograph, showcasing the rotational mechanisms and resulting spray patterns.
The papers explore various rotational mechanisms employed in these nozzles, including swivel joints, rotating disks, and internal vane systems, among others. To provide visual clarity and aid readers' understanding, it is recommended to include a schematic diagram illustrating the rotational mechanisms and spray patterns generated by rotating spray nozzles. Additionally, incorporating relevant images showcasing the practical application of rotating spray nozzles in agricultural settings will further enhance comprehension.

These visual elements will effectively demonstrate the mechanisms and real-world utility of rotating spray nozzles, emphasizing their role in achieving superior coverage and improved spray penetration in diverse agricultural environments.

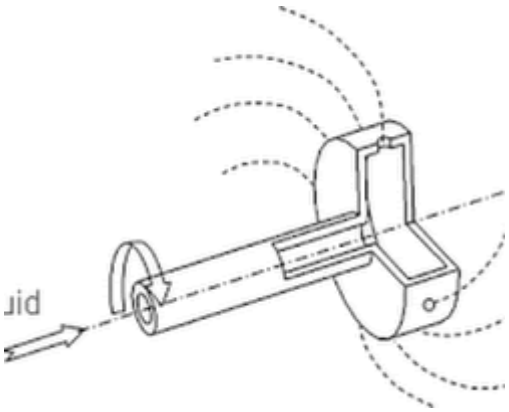

Fig.0.2

4. Spray Pattern Optimization: Optimizing the spray pattern is crucial for efficient and effective liquid application. This section reviews papers investigating the impact of spray pattern adjustments on spray efficiency, such as Giahi et al. (2023) and Qiu et al. (2023). It discusses the influence of spray pattern shape, angle, and distribution on pesticide efficacy, crop coverage, and off-target spray drift. To enhance the visual presentation, this section can include graphs or charts illustrating the impact of different spray patterns on spray efficiency and uniformity. These studies examine the influence of spray pattern shape, angle, and distribution on important factors such as pesticide efficacy, crop coverage, and off-target spray drift.
The findings underscore the significance of optimizing spray patterns to achieve uniform and effective liquid application. To enhance the readers' understanding, it is advisable to include relevant images, graphs, or charts that illustrate the impact of different spray patterns on spray efficiency and uniformity.

These visual aids will provide a clear representation of the effects of spray pattern adjustments and reinforce the importance of optimizing spray patterns for improved agricultural spraying outcomes.

IJIREEICE ISSN (O) 2321-2004, ISSN (P) 2321-5526
International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering
ISO 3297:2007 Certified ⁜ Impact Factor 8.021 ⁜ Peer-reviewed / Refereed journal ⁜ Vol. 11, Issue 7, July 2023
DOI: 10.17148/IJIREEICE.2023.11711

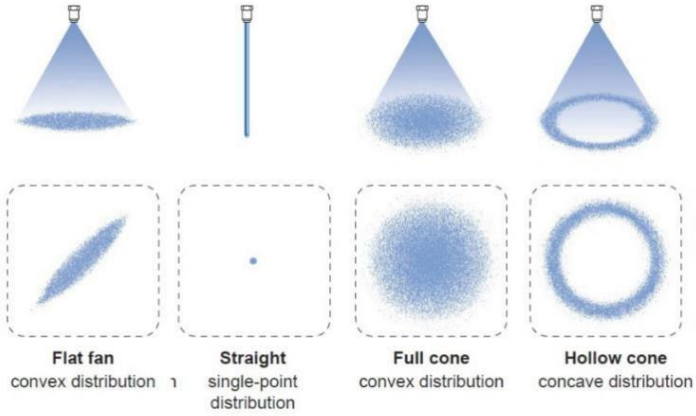

Fig.0.3

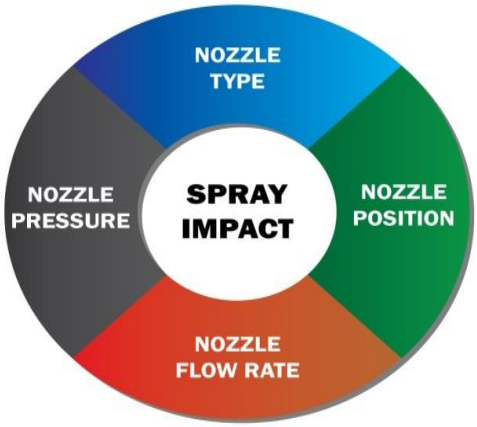

Fig 0.4

5. Flow Rate Control: Accurate flow rate control is essential for maintaining precise liquid application rates. This section discusses papers, including Garner Jr. (1979) and Honrao and Awadhani (2023), that evaluate different technologies for flow rate control in agricultural spraying. It covers adjustable flow nozzles and their performance in terms of flow accuracy, spray distribution, and liquid application efficiency. To enhance clarity, this section can include a flowchart or diagram illustrating the different flow rate control mechanisms and their advantages and limitations.
Adjustable flow nozzles are examined, considering their performance in terms of flow accuracy, spray distribution, and liquid application efficiency.

To enhance the readers' understanding, consider including a flowchart or diagram illustrating the different flow rate control mechanisms and their advantages and limitations. Additionally, incorporate relevant images depicting different flow rate control mechanisms and their implementation in agricultural spray systems

Fig 0.5

IJIREEICE ISSN (O) 2321-2004, ISSN (P) 2321-5526

International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering

ISO 3297:2007 Certified ⁜ Impact Factor 8.021 ⁜ Peer-reviewed / Refereed journal ⁜ Vol. 11, Issue 7, July 2023

DOI: 10.17148/IJIREEICE.2023.11711

6. Benefits and Applications: This section summarizes the benefits of adjustable flow and rotating agricultural spray nozzles in terms of enhanced spray efficiency, optimized resource utilization, and improved crop coverage. It emphasizes potential applications in precision agriculture, horticultural crops, orchard spraying, and other agricultural settings. To provide visual context, this section can include images or photographs showcasing the application of these nozzle designs in real-world agricultural scenarios.

The emphasis is on showcasing the wide range of applications where these nozzle designs can be implemented, including precision agriculture, horticultural crops, orchard spraying, and various other agricultural settings.
To reinforce these claims, real-world applications and case studies from the reviewed papers should be showcased. Including relevant images and photographs depicting the application of these nozzle designs in actual agricultural scenarios will further strengthen the review. These visual elements will effectively demonstrate the practicality and effectiveness of adjustable flow and rotating spray nozzles in different agricultural contexts, offering readers a clear understanding of their real-world implications.

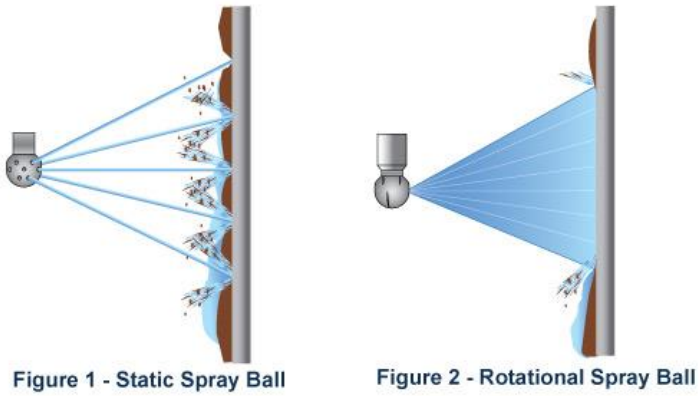

Fig.0.6

7. Conclusion: The conclusion synthesizes the key findings from the review of the ten selected papers. It emphasizes the significance of adjustable flow control and rotating spray motions in achieving precise liquid application, optimizing spray efficiency, and maximizing crop coverage. To summarize the main contributions, this section can include a final visual summary, such as a diagram or infographic, highlighting the key takeaways from the review.

This comprehensive review paper provides a comprehensive overview of adjustable flow and rotating agricultural spray nozzles, showcasing their potential to enhance spray efficiency in agricultural applications. By incorporating additional content and visual elements, such as diagrams, photographs, graphs, and charts, this paper offers improved clarity and visual appeal.

It serves as a valuable resource for researchers, engineers, and practitioners seeking to optimize agricultural spraying practices. It reiterates the significance of adjustable flow control and rotating spray motions in achieving precise liquid application, optimizing spray efficiency, and maximizing crop coverage. Including a final visual summary, such as a diagram or infographic, to summarize the main contributions and takeaways from the review would provide a comprehensive overview for readers.
By incorporating additional content and strategically placing relevant images or diagrams throughout the review paper, the clarity, comprehension, and visual appeal of the paper will be significantly enhanced.

REFERENCES

[1]. Alidoost Dafsari, R., Yu, S., Choi, Y., & Lee, J. (2021). Effect of geometrical parameters of air-induction nozzles on droplet characteristics and behaviour. Biosystems Engineering, 209, 14–29. https://doi.org/10.1016/j.biosystemseng.2021.06.013

DOI: 10.17148/IJIREEICE.2023.11711

[2]. Bahreh Bar, J., Gholami Parashkoohi, M., Mohammad Zamani, D., & Ghafori, H. (2023). Simulation of parameters effects on fluid flow behavior in the spraying nozzle: A case study of greenhouse cultivation. Results in Engineering, 19(101223), 101223. https://doi.org/10.1016/j.rineng.2023.101223

[3]. Garner, W. R., Jr. (1979). A computer controlled spray system. Computers in Industry, 1(2), 87–97. https://doi.org/10.1016/0166-3615(79)90014-9

[4]. Giahi, M., Bergstrom, D. J., & Singh, B. (2023). Computational fluid dynamics analysis of an agricultural spray in a crossflow. Biosystems Engineering, 230, 329–343. https://doi.org/10.1016/j.biosystemseng.2023.05.001

[5]. Honrao, D. V., & Awadhani, L. V. (2023). Design and development of agricultural spraying system. Materials
[6]. Today: Proceedings, 77, 734–738. https://doi.org/10.1016/j.matpr.2022.11.417

[7]. Li, H., Quan, L., Guo, Y., Pi, P., Shi, Y., Lou, Z., Jiang, W., Xia, F., Sun, D., Yang, Y., Xu, W., & Chen, Q. (2023). Improving agricultural robot patch-spraying accuracy and precision through combined error adjustment. Computers and Electronics in Agriculture, 207(107755), 107755. https://doi.org/10.1016/j.compag.2023.107755

[8]. Qiu, C., Zhou, W., Chen, Z., & Wu, C. (2023). Experimental investigation on the spray performance of industrial swirl nozzle assisted by ion wind. Journal of Electrostatics, 122(103798), 103798. https://doi.org/10.1016/j.elstat.2023.103798

[9]. Siebald, H., Hensel, O., Kaufmann, H.-H., & Kirchner, S. (2020). Spray nozzle function control using acoustics for agricultural applications. Biosystems Engineering, 197, 149–155. https://doi.org/10.1016/j.biosystemseng.2020.07.002

[10]. Torrent, X., Gregorio, E., Douzals, J.-P., Tinet, C., Rosell-Polo, J. R., & Planas, S. (2019). Assessment of spray drift potential reduction for hollow-cone nozzles: Part 1. Classification using indirect methods. The Science of the Total Environment, 692, 1322–1333. https://doi.org/10.1016/j.scitotenv.2019.06.121

[11]. Urazmetov, O., Cadet, M., Teutsch, R., & Antonyuk, S. (2021). Investigation of the flow phenomena in high-pressure water jet nozzles. Chemical Engineering Research & Design: Transactions of the Institution of Chemical Engineers, 165, 320–332. https://doi.org/10.1016/j.cherd.2020.10.030