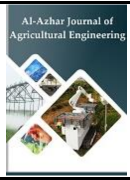
Al-Azhar Journal of Agricultural Engineering 3 (2022) 17-25

Contents lists available at Egyptian knowledge Bank (EKB)

Al-Azhar Journal of Agricultural Engineering

journal homepage: https://azeng.journals.ekb.eg/



Full length article

Field sprayer technology: acritical overview

Abdallah E. Elwakeel [a*], Saad F. Ahmed [b], Abdalla M. Zein Eldin [b], Loai Nasrat [c], Mostafa O. Hassaan [a], Mohamed M. Alsebiey [a]

[a] Department of Agricultural Engineering, Faculty of agriculture and natural resources, Aswan University, Aswan, Egypt.

[b] Department of Agricultural and Biosystems Engineering, Faculty of Agriculture, Alexandria University, Alshatby, Alexandria, Egypt.

[c] Department of Electrical Engineering, Faculty of Energy Engineering, Aswan University, Aswan, Egypt.

ARTICLE INFO

Handling Editor - Dr. Mostafa H. Fayed

Keywords:
Spraying Systems
Pesticide
Terrestrial spraying
Aerial spraying.

Agricultural Machinery & Power Engineering

ABSTRACT

Farmers use different types of sprayers for the management of the pest. Successful pest management depends not only on the quality of the pesticide and insecticides but also on the use of the right plant protection appliances. Hence, proper selection based on ergonomic, economic, efficacy, and ecological and use of equipment for pesticide application has a direct effect on crop productivity. Normally, the spray efficiency, which usually is estimated by cost-income of the agricultural industry, increases from hand-operated sprayers with low application rate, small coverage area in a certain time interval, and low travel speed to large-scale sprayers which could apply pesticide with much higher application rate, bigger coverage area in a certain time interval and higher travel speed. This research aims to identify and inventory the different types of pesticide application systems used around the world.

1. Introduction

Farmers use different types of sprayers for the management of the pest. Successful pest management depends not only on the quality of the pesticide and insecticides but also on the use of the right plant protection appliances. Hence, proper selection based on Ergonomic, Economic, Efficacy, and Ecological and use of equipment for pesticide application has a direct effect on crop productivity (Pankaj and Shashidhar, 2018). Sammons et al. (2005) reported that pesticide spraying in agricultural crop fields is generally performed in two ways, namely: (i) terrestrial and (ii) aerial. In the terrestrial way, which is largely based on ground vehicles, paths are needed within the crop field, as the vehicles require permanent contact with the ground during locomotion. The spraying system must be close to the culture, which reduces the drift of pesticides to neighboring areas. Additionally, terrestrial spraying can reach a higher accuracy of spraying distribution in favorable conditions. For example, it can attend demands of a specific culture. On the other hand, this spraying approach is usually slow and has contact with the culture, which decreases the production area and can damage healthy plants. In contrast, aerial spraying allows faster spraying without the need for paths inside the crop field. However, the larger distance between the spraying system and the cultivated area increases pesticide drift to neighboring areas (Nádasi and Szabó, 2011).

2. Literature review

The pesticide spraying in agricultural crop fields is generally performed in two ways, namely: (i) terrestrial and (ii) aerial. In the terrestrial way, which is largely based on ground machines, paths are needed within the crop field, as the vehicles require permanent contact with the ground during locomotion (Sammons et al., 2005). The spraying system must be close to the culture, which reduces the drift of pesticides to neighboring areas. Additionally, terrestrial spraying can reach a higher accuracy of spraying distribution in favorable

* Corresponding authors.
E-mail address: Abdallah_elshawadfy@agr.aswu.edu.eg (Abdallah E. Elwakeel).

Peer review under responsibility of Faculty of Agricultural Engineering, Al-Azhar University, Cairo, Egypt.
Received 22 April 2022; Received in revised form 18 May 2022; Accepted 20 April 2022
Available online 3 August 2022

conditions. For example, it can attend demands of a specific culture. On the other hand, this spraying approach is usually slow and has contact with the culture, which decreases the production area and can damage healthy plants. In contrast, aerial spraying allows faster spraying without the need for paths inside the crop field. However, the larger distance between the spraying system and the cultivated area increases pesticide drift to neighboring areas (Nádasi and Szabó, 2011).

2.1. Aerial spraying

As much as India depends upon agriculture, still it is far short of adopting the latest technologies in it to get a good farm. Developed countries have already started the use of unmanned aerial vehicles (UAV's) in their precision agriculture photogrammetry and remote sensing (Aditya and Kulkarni, 2016). It is very fast, and it could reduce the workload of a farmer. In general, UAVs are equipped with cameras and sensors for crop monitoring and sprayers for pesticide spraying. In the past, a Variety of UAV models ran on military and civilian applications (Van-Blyenburgh, 1999).

In agriculture, the first UAV model is developed by Yamaha. Unmanned helicopter Yamaha RMAX was introduced for agriculture pest control and crop monitoring applications. However, Yamaha stopped their production in 2007. Technical analysis of UAVs in precision agriculture is to analyze their applicability in agriculture operations like crop monitoring, crop height Estimations Pesticide Spraying, soil, and field analysis (Colomina and Molina, 2014).

UM and Deepak (2018) reported that Unmanned Aerial Vehicle (UAV) is an aircraft that can fly without a human pilot and is controlled by the radio channel. Multi-rotors are the one type of UAVs, further which are classified into several rotors in their platform:

1. Fixed wing (Fig. 1a) UAVs are entirely different in their design compared to multi-rotors and the aerodynamic shape of two wings are gives an easy glide of UA (Pederi and Cheporniuk, 2015).
2. A single-rotor helicopter (Fig. 1b) is a model that has just one big-sized rotor on top and one small-sized one on the tail of the UAV (Huang et al., 2009).
3. Quad copter (Fig. 1c) (Spoorthi et al., 2017).
4. Hexa copter (Fig. 1d) (Spoorthi et al., 2017).
5. Octo copters (Fig. 1e) are multi-rotors that are lifted and propelled by four, six, eight rotors (Bendig et al., 2012).

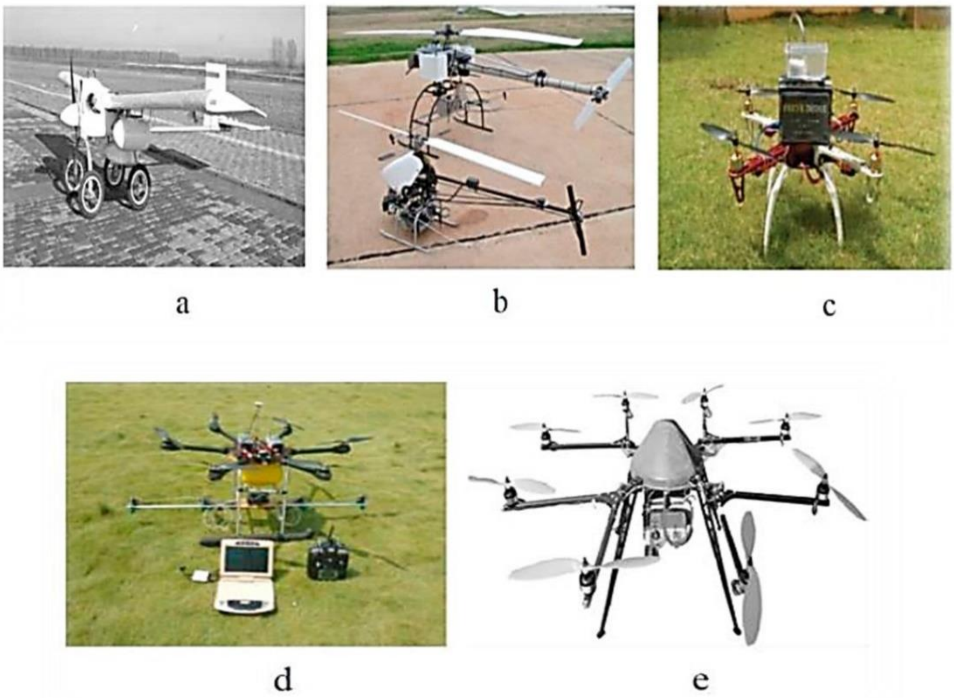


Fig. 1. UAV types, Fixed Wing (a). Single rotor (b). Quadcopter (c). Hexa copter (d). Octo copter (e). (Pederi and Cheporniuk, 2015; Huang et al., 2009; Spoorthi et al., 2017; Bendig et al., 2012).

2.2. Terrestrial spraying

Pérez-Ruiz et al. (2015) stated that another form of production is the cultivation of open field crops. This allows extensive crop fields and, hence, large-scale production. On the other hand, this alternative is the most expensive agricultural production, since it requires a larger amount of machinery and more workers to carry out activities on time. And they also, surveyed the highlighted the considerable progress made in this context, which includes:

(i) Autonomous tractors,

(ii) Communication systems and the Global Positioning System,

(iii) A design for an intelligent spray bar, and

(iv) Thermal and mechanical systems to control weeds.

And the good preliminary results obtained in these areas show a promising future for the development and use of autonomous vehicles for precision agriculture. Despite making significant advances, land vehicles (whether autonomous or manned) must use routes within the plantation, and this reduces the production area. Moreover, deviations in the route already established can damage healthy plants and further reduce productivity, since these machines enter the crop field several times during the production phase.

Molari et al. (2005) designed a recycling tunnel sprayer using computational fluid dynamics (CFD) simulation and reported that tunnel sprayers have the potential to cut back both drift and runoff, also reducing the quantity of pesticide required and costs.

Fig. 2. A recycling tunnel sprayer (Molari et al., 2005).

Rayner (2010) designed and fabricated a vehicle-mounted digital, positioning spray system. The item of the invention was to supply a high volume, low cost, sealant spray system for the asphalt industry, accomplished particularly through a self-contained vehicle-mounted spray system utilizing a digital positioning receiver consisting of a worldwide positioning system (GPS) or horn radar for vehicle speed sensing and a motor rpm sensor and a program logic microcontroller for adjusting output flow of a cloth pump to attain a target application spray rate of a spraying bar.

Amonye et al. (2014) designed and developed of animal-drawn ground metered axle mechanism boom sprayer. The spraying technology was developed to be used by rural farmers in Northern Nigeria. The equipment was constructed using the parameters obtained from design and tested at farmland within the University premises of Ahmadu Bello University, Zaria, in Nigeria. The equipment consists of a boom with multiple controlled droplet applicator (CDA) atomizer nozzles, a gear pump, a chemical tank, and a chair for an operator; all attached to a framework bolted to a rear axle.

Abdelmotaleb et al. (2015) developed an autonomous navigation agricultural robotic platform (ARP) based on machine vision. The ARP consisted of two main parts namely, 1) Power transmission and auto-guide system; and 2) Robotic platform. The experiments were carried out at the department of agricultural engineering, faculty of agriculture, Kafr elsheikh University during 2014-2015. In their study, the experiments were conducted in the laboratory to optimize the accuracy of ARP control using machine vision in terms of the autonomous navigation and performance of the robot's guidance system.

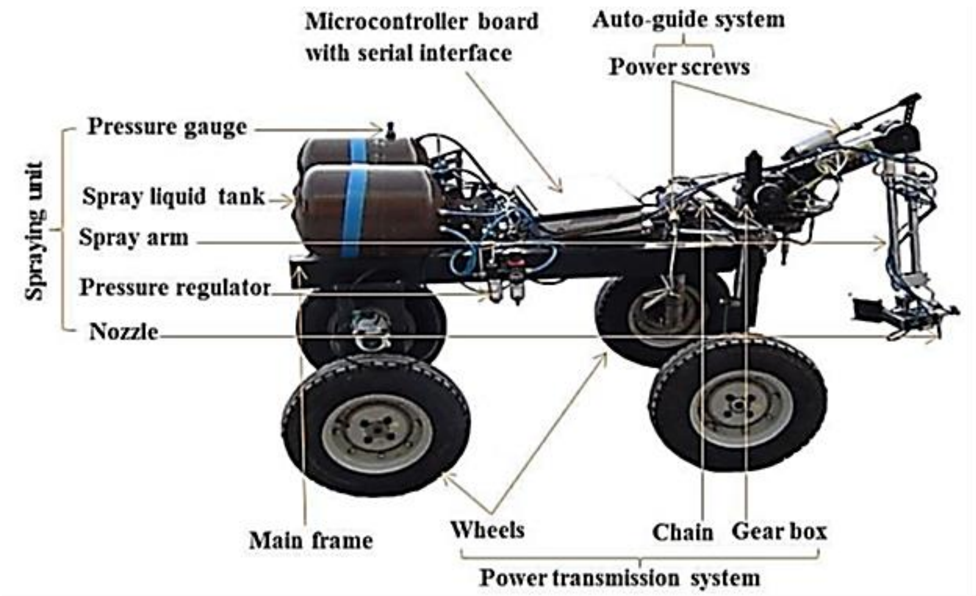


Fig. 3. Main components of agricultural robotic platform (ARP) (Abdelmotaleb et al., 2015).

The average lateral error of autonomous was 2.75, 19.33, 21.22, 34.18 and16.69 mm, while the average lateral error of human operator was 32.70, 4.85, 7.85, 38.35, and 14.75 mm for straight path, curved path, sine wave path, offset discontinuity, and angle discontinuity, respectively. The best execution time of image processing was obtained with the minimum values of the camera resolution at 500 mm camera height. While increasing the size of the nozzle at the same height and spray pressure decreased the flight time. The favorable robotic platform's speeds were obtained at lower values of camera resolutions and wider distances between nozzle and camera.

Kang et al. (2015) developed a wireless remote-controlled (RC) spraying machine that supported the S3C6410 embedded controller. This spraying machine consists of a rotary pesticide selection unit, a real-time mixing unit, a multi-angle spraying unit, a picture acquisition module, an embedded control module, a wireless communication module, and an intelligent mobile platform. it's specially designed for hilly areas, greenhouses, orchards, and other environments that don't seem to be accessible to large and medium-sized spraying machines. The wireless (RC) machine achieves precise proportional and multi-angle flexible spraying while avoiding liquid waste and direct operator–liquid contact.

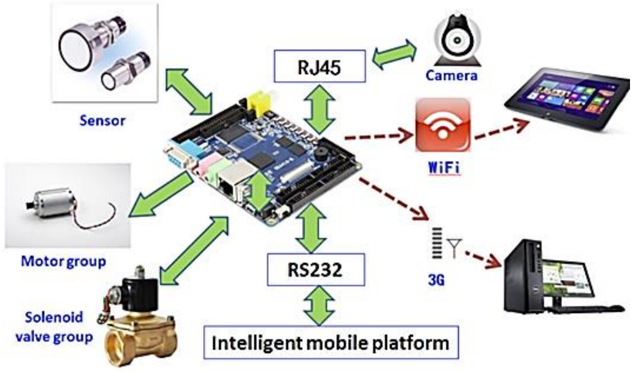


Fig. 4. Structure diagram of the wireless monitoring system (Kang et al., 2015).

Gonzalez-de-Soto et al. (2016) developed and evaluated a robotized patch sprayer, the robotized patch sprayer consisted of an autonomous mobile robot-supported and agricultural vehicle chassis and a direct-injection spraying boom that was tailor-made to interact with the mobile robot. There have been diverse sources (onboard and remote sensors) that will supply the weed data for the treatment. Laboratory characterization and field tests demonstrated that the system was reliable and accurate enough to accomplish the treatment of over 99.5 % of the detected weeds and treatment of the crop with no weed treated was insignificant; approximately 0.5 % with relation to the entire weed patches area, achieving major herbicide savings.

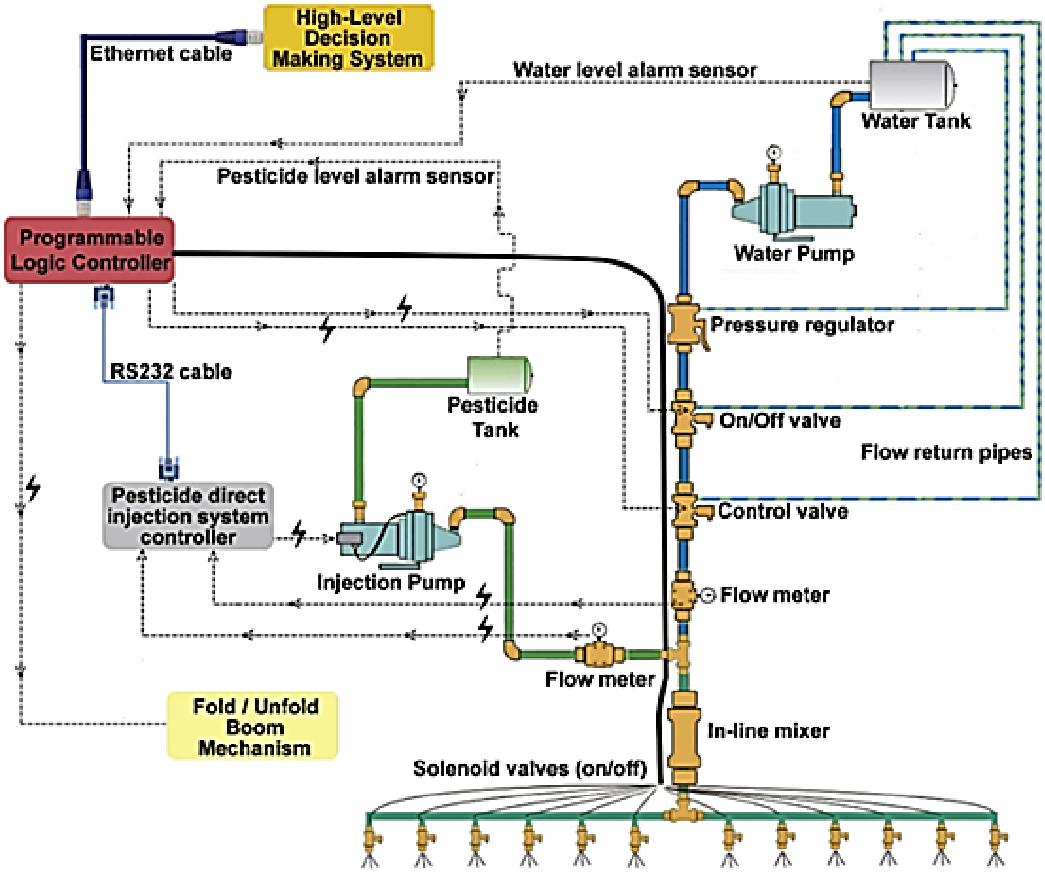


Fig. 5. Simplified schematic diagram of the fundamental spraying components (Gonzalez-de-Soto et al., 2016).

Adamides et al. (2017) designed and developed a semi-autonomous agricultural vineyard sprayer. The sphere experiment evaluated the effect of three design factors: (a) style of screen output, (b) number of views, (c) style of robot control data input device. Results showed that participants were significantly simpler but less efficient after they had multiple views than after they had one view. PC keyboard was also found to significantly outperform PS3 gamepad in terms of interaction efficiency and perceived usability. Heuristic evaluations of various user interfaces were also performed using research-based HRI (Human-robot interaction) heuristics. Finally, a study on participants' overall user experience found that the system was evaluated positively on the user experience questionnaire scales.

Fig. 6. Semi-autonomous agricultural vineyard sprayer (Adamides et al., 2017).

Yamane and Miyazaki (2017) developed an electrostatic pesticide spraying system as shown in Fig. 7, for low-concentration, high-volume applications to scale back vegetable production costs through savings in agricultural chemical usage and dealing hours for pest control. the opposite type was a spraying robot for greenhouse melons. There was no significant difference within the control of insect pests between robot spraying and the conventional manual spraying method. The effective displacement unit of the robot was 3.8 a/h.

Pranoy et al. (2017) designed and fabricated of pesticide series spraying machine for multiple crops. The model was designed by using CATIA and fabrication was allotted by different techniques. Real-time testing was allotted at different crops.

Fig. 7. Spraying robot for greenhouse melons (Yamane and Miyazaki, 2017).

Fig. 8. Pesticide series spraying machine (Pranoy et al., 2017).

Akshaya et al. (2017) developed of mechanically operated pesticide sprayer & fertilizer dispenser. The design has many variables that would be altered to reinforce the utility of the vehicle. Increasing tank capacity by addition of another tank with a pump. The frame is often fabricated from Aluminum alloy with a thicker gauge, which is light in weight and sturdy. The addition of more nozzles is often done to increase the realm covered by the machine at any given time, to take care of the identical pressure all told nozzles, an external pump is also required.

Fig. 9. A mechanically operated pesticide sprayer and fertilizer dispenser (Akshaya et al., 2017).

Sarri (2017) designed and tested a low-cost micro-volume sprayer for bait spraying. An electrical sprayer with an automatic spray controller based on an open-source Arduino platform was designed. The prototype was tested in laboratory condition and on cherry growing for two seasons in center Italy to assess the operative reliability. Results showed the efficiency of the sprayer and the use of bait (Spintor-Fly ®) to control the cherry pomace fly.

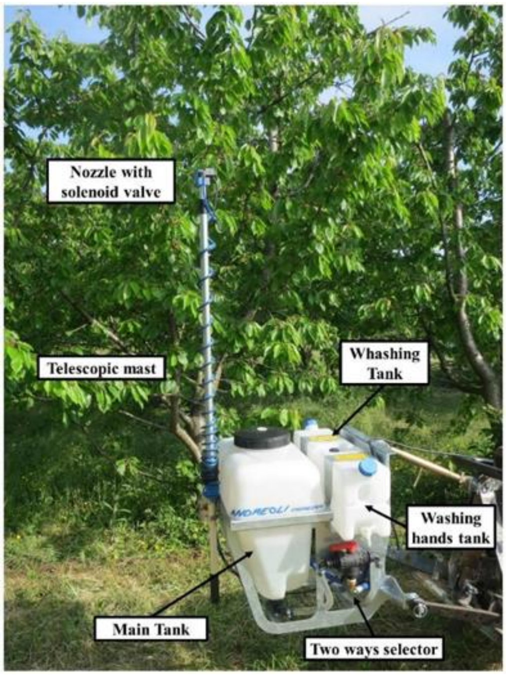


Fig. 10. Main elements of the micro-volume sprayer for bait spraying (Sarri, 2017).

Singh et al. (2018) developed a solar-operated knapsack sprayer as shown in Fig. 11, to avoid problems like electricity shortage, fatigue thanks to continuous operating of a manual knapsack sprayer and other difficulties in engine operated sprayer.

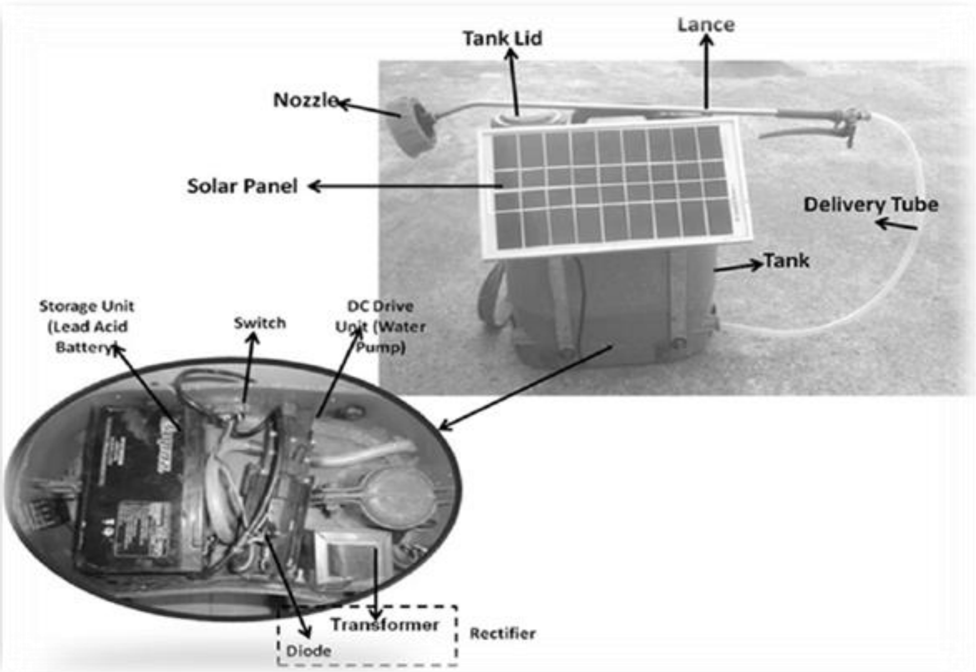


Fig. 11. Solar sprayer-operated knapsack sprayer (Singh et al., 2018).

Nangare et al. (2018) designed and fabricated an agricultural sprayer. The model runs non-fuel and is straightforward to control for a user. The motive behind developing this equipment is to make mechanizations that can help to attenuate effort and also the operator fatigue and canopy the utmost area within minimum time as compared to a single sprayer. it's suitable for spraying at minimum costs for the farmers.

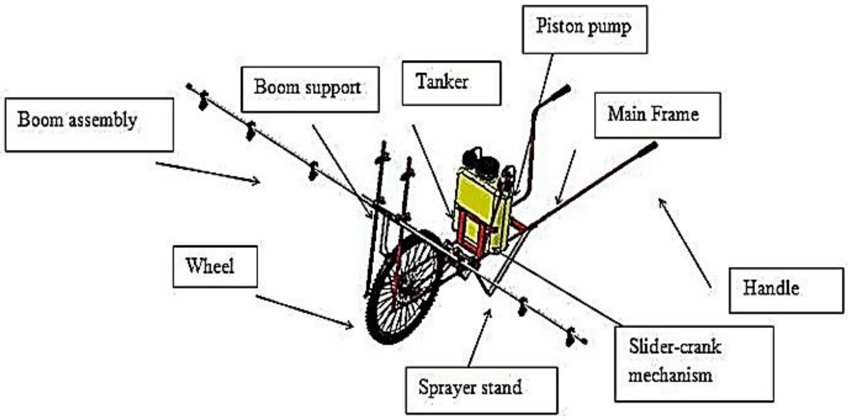


Fig. 12. Complete sprayer assembly parts (Nangare et al., 2018).

Sivanainthaperumal et al., (2018) designed and developed a wheel-spray pump. The spryer was mechanically operated wheel driven, it had been a transportable device and did not need any fuel to operate, which is straightforward to maneuver and spray the pesticide by moving the wheel. This wheel-operated pesticide spray equipment consumes less time and achieves uniform nozzle pressure; a crank mechanism with a piston pump was used, which was driven by the wheel.

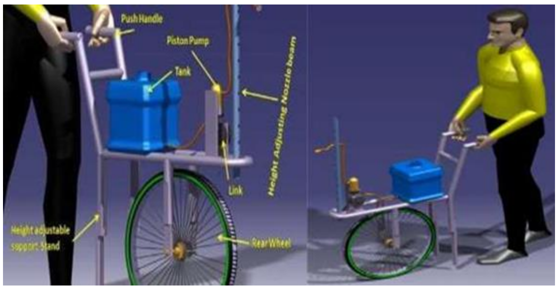


Fig. 13. Main components of the wheel spray pump (Sivanainthaperumal et al., 2018).

Meganathan et al. (2018) designed and fabricated a mechanical pesticide sprayer. The machine consumes less time and saves money as compared with conventional spraying. It covers twice the area of spraying than manually spraying. It does spray in less amount of time than that the conventional method dose. This machine does not require any fuel or power, so maintenance is a smaller amount.

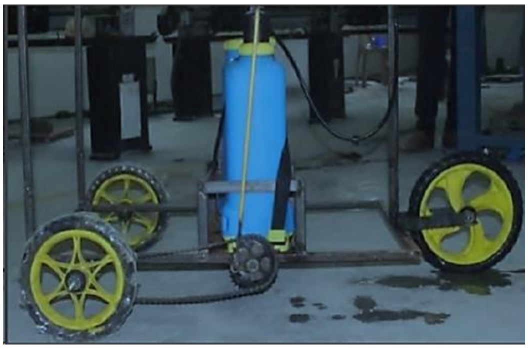


Fig. 14. Side view of the pesticide sprayer (Meganathan et al., 2018).

Shabareesha et al. (2019) designed and fabricated a multipurpose hybrid sprayer. The sprayer was designed considering parameters like desired spraying efficiency, user-friendly, low operating time, and faster coverage of the area. Thus, the sprayer was designed to be a price-for-money product within the agriculture sector.

Fig. 15. The final image of the multipurpose hybrid sprayer (Shabareesha et al., 2019).

Penido et al. (2019) developed and evaluated a remotely controlled and monitored self-propelled sprayer in tomato crops. The fundamental prototype comprises an agricultural mini tractor, a motorized pneumatic sprayer (atomizer), and a group of electronic and mechanical sensors and actuators, which permit the assembly to be controlled remotely and pictures captured by a video camera to be viewed on a tablet. After development, the principal dimension, weight, and operational characteristics of the prototype were identified. Also, the prototype was used for spraying ten tomato plants within the crop, with seven different points being observed for every plant. The results were analyzed statistically, giving the subsequent coefficients of variation: 15.13 % for spray coverage, 18.70 % for droplet density, and 16.68% for product deposition on the folioles. supported these values, it had been concluded that the event of a remotely controlled and monitored self-propelled sprayer prototype, and it is used in spraying tomato crops, were viable.

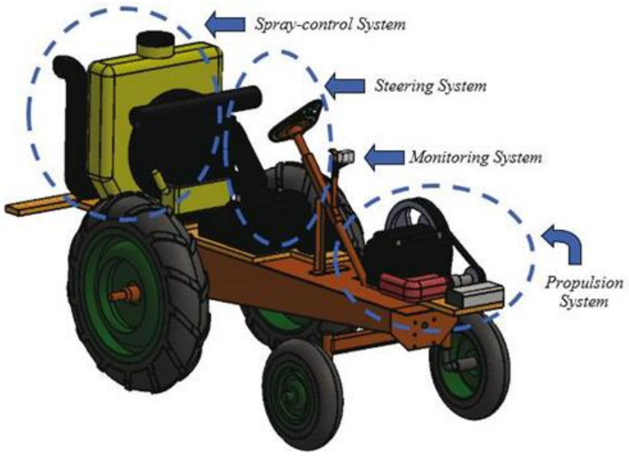


Fig. 16. Propulsion, steering, spray control, and monitoring system (Penido et al., 2019).

3. Conclusions

In this agriculture sector, there is a lot of fieldwork, such as weeding, reaping, sowing, etc. Apart from these operations, spraying is also an important operation to be performed by the farmer to protect the cultivated crops from insects, pests, funguses, and diseases for which various insecticides, pesticides, fungicides, and nutrients are sprayed on crops for protection. The growing concern to control plant diseases, insects, and weeds for a qualitative yield of agricultural products is increasing speedily in many developing countries.

References

Abdelmotaleb, I., Hegazy, R., Imara, Z., Rezk, A., 2015. Development of an autonomous navigation agricultural robotic platform based on machine vision. Misr Journal of Agricultural Engineering 32(4): 1421 – 1450.

Adamides, G., Katsanos, C., Constantinou, I., Christou, G., Xenos, M., Hadzilacos, T., Edan, Y., 2017. Design and development of a semi-autonomous agricultural vineyard sprayer: Human-robot interaction aspects. Journal of Field Robotics 34:1407–1426.

Aditya, S.N., Kulkarni, S.C., 2016. Adoption and Utilization of Drones for Advanced Precision Farming: A Review. International Journal on Recent and Innovation Trends in Computing and Communication, ISSN: 2321-8169, 4 (5), PP. 563 - 565. 7- Van-Blyenburgh, P. (1999): UAVs: an overview. Air & Space Europe, 1(5-6), pp.43-47.

Akshaya, C., Shirwal, A.R., Bharadwaj, A., Kumar, T.N., Harish, T., Shankara, D.R., 2017. Development of mechanically operated pesticide sprayer and fertilizer dispenser. International Journal for Scientific Research and Development 5(4) 2321-0613

Amonye, M.C., Suleiman, M.L., El-Okene, A., Abdulmalik I. O., Makoyo, M., 2014. Design and development of animal drawn ground metered axle mechanism boom sprayer. International Journal of Engineering Research and Applications 4(9): 01-09.

Bendig, J., Bolten, A., Bareth, G. 2012. Introducing a low-cost mini-UAV for thermal-and multispectral-imaging. Int. Arch. Photogram. Remote Sens. Spat. Inf. Sci, 39, pp.345-349.

Colomina, I., Molina, P., 2014. Unmanned aerial systems for photogrammetry and remote sensing: A review. ISPRS Journal of Photogrammetry and Remote Sensing, 92, pp.79-97.

Food and Agriculture Organization of the United Nations (FAO), 2005. International code of 80 conducts on the distribution and use of pesticides, revised version. Rome. P6.

Gonzalez-de-Soto, M., Emmi, L., Perez-Ruiz, M., Aguera, J., Gonzalez-de-Santos, P., 2016. Autonomous systems for precise spraying e Evaluation of a robotized patch sprayer. 13th International Journal on Recent Innovation in Science, Engineering and Management, 1-18.

Huang, Y., Hoffmann, W.C., Lan, Y., Wu, W., Fritz, B.K., 2009. Development of a spray system for an unmanned aerial vehicle platform. American Society of Agricultural and Biological Engineers ISSN 0883-8542. 25(6): 803-809.

Kang, Z., Zhiyong, L.X., Cheng, Z.L., 2015. Key technologies of spraying machine with wireless remote control. International Journal of Online Engineering, 11:3.

Meganathan, D., Venu, P., Mohan, T.R., Maravan, A., 2018. Design and fabrication of mechanical pesticide sprayer. International Journal of Research Culture Society 2(4).

Molari, G., Benini, L., Ade, G., 2005. Design of a recycling tunnel sprayer using CFD simulations. Trans. American Society of Agricultural Engineering 48(2): 463–468.

Nádasi, P., Szabó, I., 2011. On-board applicability of mems-based autonomous navigation system on agricultural aircraft. Hung. J. Ind. Chem. 39 (2), 229–232.

Nádasi, P., Szabó, I., 2011. Onboard applicability of mems-based autonomous navigation system on agricultural aircraft. Hung. Journal of Industrial and Engineering Chemistry 39 (2), 229–232.

Nangare, S.T., Patil, S.S., Ikile, G.P., Jangate, S.R., Patil, A.M., Nalawade, D.K., 2018. Design and Fabrication of Agricultural Sprayer. 13th International Conference of Recent Innovations in Science, Engineering, And Management, 252-259.

Pankaj, B.G., Shashidhar, S.K.,2018. A Review on Pesticides Sprayer Technology Approach in Ergonomics, Economics, and Ecologic in Agriculture Field. International Journal of Engineering Science Invention (IJESI). E-ISSN: 2319 – 6734, p- ISSN: 2319 – 6726. www.ijesi.org, 7 (9), PP 01-05.

Pankaj, B.G., Shashidhar., S.K., 2018. A Review on Pesticides Sprayer Technology Approach in Ergonomics, Economics and Ecologic in Agriculture Field. International Journal of Engineering Science Invention 7 (9): 01-05.

Panopoulos, P.J., 2005. Design and fabricate a machine that is an automatic pesticide, insecticide, repellant, poison, air freshener, disinfectant, or other types of spray delivery system. USA patent No. 2005/0224.596 A1.

Pederi, Y.A., Cheporniuk, H.S., 2015. Unmanned Aerial Vehicles and new technological methods of monitoring and crop protection in precision agriculture. In Actual Problems of Unmanned Aerial Vehicles Developments (APUAVD), IEEE International Conference, pp. 298-301. IEEE.

Penido, É.C.C., Teixeira, M.M., Fernandes, H.C., Barros, Monteiro, P., Cecon, P.R., 2019. Development and evaluation of a remotely controlled and monitored self-propelled sprayer in tomato crops. Revista Ciência Agronômica 50(1): 8-17.

Pérez-Ruiz, M., Gonzalez-de, S.P., Ribeiro, A., Fernandez, C., Quintanilla, P.A., Vieri, M., Tomic, S., Agüera, J., 2015. Highlights and preliminary results for autonomous crop protection. Computers and Electronics in Agriculture 110: 150–161.

Pranoy, V., Subrahmanyam, T.D.S., Kumar, C.M., Babu, R., 2017. Design and fabrication of pesticide series spraying machine for multiple agricultural crops. International Journal for Research in Applied Science and Engineering Technology, 5(10):1038-1042.

Rayner, R.D., 2010. Vehicle-mounted digital positioning spray system. USA patent No. 7,802,737.

Sammons, P.J., Furukawa, T., Bulgin, A., 2005. Autonomous pesticide spraying robot for use in a greenhouse. In:

Australian Conference on Robotics and Automation pp. 1–9.

Sammons, P.J., Furukawa, T., Bulgin, A., 2005. Autonomous pesticide spraying robot for use in a greenhouse. In: Australian Conference on Robotics and Automation, pp. 1–9.

Sarri, D., 2017. design and testing of a low-cost micro-volume sprayer for bait spraying. Contemporary Engineering Sciences 10(4): 179-192.

Shabareesha, A., Jaswanth, T.S., Sankarshana, S.V., Manju, P., 2019. Design and Fabrication of Multipurpose Hybrid Sprayer. International Journal for Research in Applied Science and Engineering Technology ISSN: 2321-9653; 7(6).

Singh, K., Padhee, D., Parmar, A.K., Sinha, B.L., 2018. Development of a solar-powered knapsack sprayer. Journal of Pharmacognosy and Phytochemistry 7(1): 1269-1272.

Sivanainthaperumal, T., Selvam, M., Pandiyaraj, R., Arunraj, S., 2018. Design and development of wheel-spray pump. International Journal of Emerging Technology in Computer Science and Electronics ISSN: 0976-1353, 25(5) (Special Issue).

Spoorthi, S., Shadaksharappa, B., Suraj, S., Manasa, V.K., 2017. Freyr drone: Pesticide/fertilizers spraying drone-an agricultural approach. IEEE 2nd International Conference on In Computing and Communications Technologies (ICCCT), pp. 252-255.

UM, R.M., Deepak, B.B.V.L., 2018. Review on Application of Drone Systems in Precision Agriculture. International Conference on Robotics and Smart Manufacturing. Procedia Computer Science, 133, 502–509.

Yallappa, D., Veerangouda, M., Maski, D., Palled, V., Bheemanna, M., 2017. Development and evaluation of drone-mounted sprayer for pesticide applications to crops. IEEE Global Humanitarian Technology Conference (GHTC) pp. 1-7.

Yamane, S., Miyazaki, M., 2017. Review Study on Electrostatic Pesticide Spraying System for Low-Concentration, High-Volume Applications. Japan Agricultural Research Quarterly 51(1):11-16.

دراسة مرجعية عن نظم الرش الحقلي

عبد الله الشوادفي الوكيل[١]، سعد فتح الله أحمد[٢]، عبد الله مسعد زين الدين[٢]، لؤي سعد الدين نصرت[٣]، مصطفى عمر حسان[١]، محمد محمود السبيعي[١]

[١] قسم الهندسة الزراعية، كلية الزراعة والموارد الطبيعية، جامعة أسوان، أسوان، مصر.
[٢] قسم الهندسة الزراعية والنظم الحيوية، كلية الزراعة، جامعة الإسكندرية، الشاطبي، الإسكندرية، مصر.
[٣] قسم الهندسة الكهربائية، كلية الهندسة، جامعة أسوان، أسوان، مصر.

الملخص العربي

يستخدم المزارعون أنواعاً مختلفة من آلات الرش لمكافحة الآفات. لا تعتمد المكافحة الناجحة للآفات على جودة المبيدات الحشرية فحسب، بل تعتمد أيضاً على استخدام الآلات المناسبة لوقاية النباتات. ومن ثم، فإن الاختيار المناسب على أسس الراحة، والاقتصادية، والفاعلية، والبيئية، واستخدام الآلات لرش مبيدات الآفات له تأثير مباشر على إنتاجية المحاصيل. عادة، تزداد كفاءة الرش، والتي يتم تقديرها عادةً من خلال تكاليف مدخلات العملية الزراعية، من الرشاش الذي يتم تشغيله يدوياً بمعدل رش منخفض، ومساحة تغطية صغيرة في فترة زمنية معينة وسرعة انتقال منخفضة إلى آلات الرش الكبيرة التي يمكن أن تستخدم مبيدات الآفات مع معدل رش أعلى بكثير، ومساحة تغطية أكبر في فترة زمنية معينة وأيضاً السرعة العالية في العمل والتنقل. يهدف هذا البحث إلى تحديد وحصر الأنواع المختلفة لأنظمة رش مبيدات الآفات المستخدمة في جميع أنحاء العالم.