International Journal of Agriculture Sciences
ISSN: 0975-3710 & E-ISSN: 0975-9107, Volume 15, Issue 7, 2023, pp.-12476-12478.
Available online at https://bioinfopublication.org/pages/jouarchive.php?id=BPJ0000217

Research Article

FIELD STUDY ON UAV TECHNOLOGY IN AGRO-CHEMICAL SPRAYING

E. RAVI GOUD*[1], G. DHANALAKSHMI[2], M. ADINARAYANA[3] AND M. SUDHAKAR[4]

[1]Subject Matter Specialist (Agril. Extension), Shri Hanumantharaya Educational and Charitable Society, ICAR-Krishi Vigyan Kendra, Yagantipalle, 518124, India
[2]Senior Scientist and Head, Shri Hanumantharaya Educational and Charitable Society, ICAR-Krishi Vigyan Kendra, Yagantipalle, 518124, India
[3]Subject Matter Specialist (Horticulture), Shri Hanumantharaya Educational and Charitable Society, ICAR-Krishi Vigyan Kendra, Yagantipalle, 518124, India
[4]Subject Matter Specialist (Agronomy), Shri Hanumantharaya Educational and Charitable Society, ICAR-Krishi Vigyan Kendra, Yagantipalle, 518124, India
*Corresponding Author: Email - eravigoud068@gmail.com

Received: June 05, 2023; Revised: July 26, 2023; Accepted: July 28, 2023; Published: July 30, 2023

Abstract: The current study was carried out in 2022-2023 using an Ex-Post-Facto research design, with the objectives of drone perception and field performance. The study was conducted in the Krishi Vigyan Kendra operational areas of Nandyal District, Andhra Pradesh. Different horticultural and agricultural crops that were sprayed with drone more than twice were assessed for their field performance. It came to light that chickpea, Paddy, Maize / Redgram had superior field efficiency, with respective values of 44.85%, 43.57%, and 40.80%. In horticultural crops like citrus and mango (12-year orchard) observed 39. 24% field efficiency. With a mean score of 4.76 in the technological perception category, 93.33 percent of farmers were of the opinion that drones will cover a wider area in a short period of time (5 min./ac.), Despite a 5.0 mean score. They also thought that using fewer chemicals and reducing waste would reduce wasteful spending, and this perspective was supported by a 4.15 mean score under the category of economic perception. But based on comments from 53.33 percent of farmers, it was derived that even at a cost of Rs. 500 per acre for drone spraying, will not lower labour costs for small and marginal farmers.

Keywords: *Drone (UAV) Technology, Agro-Chemical spraying, Field efficiency*

Citation: E. Ravi Goud, *et al*., (2023) Field Study on UAV Technology in Agro-Chemical Spraying. International Journal of Agriculture Sciences, ISSN: 0975-3710 & E-ISSN: 0975-9107, Volume 15, Issue 7, pp.- 12476-12478.

Introduction

Modern agriculture is a flexible system of farming practices and technologies that enable farmers to increase production while coping with the rapid rate of population growth in the world. For adequately meet global population growth rate, it is now expected that the application of technology to agricultural practices must have to achieve more precision and production [1,2]. Achieving precision in agricultural practices involves the application of farm inputs like seedlings and agro-chemicals according to the exact needs and requirements of farmland. India is heavily dependent on agriculture, yet it is still far from adopting cutting-edge technologies to efficient farming methods. There are several technologies used in agriculture today, and one of the newest in precision farming is the use of drones to spray agro-chemicals. India's economy heavily relies on agriculture, yet it still lags behind western nations in terms of implementing modern technology to boost farm productivity [3].

To ensure agriculture profitability, we must minimize traditional approaches and embrace new technologies [4]. Developed countries, like Japan was the first country to successfully apply UAS technology in agricultural chemical spraying applications in 1980s [5,6]. It is very fast and it could reduce the workload of the farmer and make it possible to overcome the labour shortage.

The majority of spraying activities in India are done using conventional techniques, such as hand-operated sprayers (manual spraying) and tractor-operated sprayers, which leads to an excessive application of chemicals and makes it challenging to spray in paddy, orchard, and dense crop fields [7,8]. While handling agro-chemicals 88 per cent of the farmers were not following any precautions [9]. In recent years, at least 50 farmers have lost their lives and 800 farmers have been admitted to hospitals due to pesticide poisoning which was occurred in major cotton growing region of Maharashtra [10]. On this connection, drone technology gives hope for farming community to limit direct contact with harmful chemicals while spraying.

In this context a study was taken up to know the perception of farmers towards drone technology and to evaluate field level performance of drone on agro-chemical spraying in operational area of Krishi Vigyan Kendra, Yagantipalle, Andhra Pradesh under the agriculture drone project.

Materials and Methods

The present study was conducted during the year 2022-23 by following Ex-Post-Facto research design. The investigation was carried out inKrishiVigyan Kendra operational areas of Nandyal District in Andhra Pradesh. Farmers were selected purposively based on the drone sprayings done more than two times in their fields under the Agriculture Drone Project (ADP) conducted by KVK, in different mandals of Nandyal district, by covering major field and horticultural crops. Out of 29 mandals, three mandals namely Bethamcherla, Allagadda and Banaganapalle were purposively selected as the project was implemented in the three mandals. From each selected mandal 20 farmers were selected by a simple random sampling procedure (20×3=60) and a total of 60 farmers comprised the sample. The collected data was coded, classified, and tabulated with the help of appropriate statistical tools to draw meaningful conclusions. The study was taken up with the objectives of perception and field performance of drone. Under perception, statements were categorized in to technological, economical, and social aspects. Perception was measured on 1 to 3 continuum scale. The mean score was used to determine the ranking. Higher mean scores suggest a more agreed-upon statement, whereas lower mean scores indicate a more disagreed-upon statement. Apartfrom this, evaluated field performance of the drone in farmers field as described by Kepner, *et al*. (1987) [11].

TFC (Ha/h) = Spray width (m) x Forward speed (km/h)
EFC (Ha/h) = Area coverd (Ha) / Average time taken (h)
FE (%) = [[EFC (Ha/h)] / [TFC(Ha/h)]] x 100

Table-1 Distribution of farmers based on technological perception on drone technology (n=60)

Technological aspects	Agree	Neutral	Disagree	MWS
Recommended dosage of chemical not possible with drone	23.33	23.33	53.33	3.21
Drone usage leads to uniform spraying of chemicals	71.66	0.00	28.33	4.05
Drone usage helps to cover larger area in short period	93.33	0.00	6.66	4.76
Possibility of spray drifts to the nearby crop fields	68.33	5.00	26.66	4.02
Drone is more useful in Horti. Crops *i.e.*, citrus, mango, sapota than field crops	76.66	8.33	15.00	4.35
Immediately after irrigation we can go for spraying with drone	88.33	0.00	11.66	4.60
It more useful in tall and dense crops *i.e.*, Maize, Jowar and Redgram	80.00	0.00	20.00	4.33
It more useful in undulated geographical areas	35.00	30.00	35.00	3.33

Table-2 Distribution of farmers based on economical perception on drone technology (n=60)

Economical Aspects	Agree	Neutral	Disagree	MWS
Reduce the labour cost than conventional/traditional methods.	20.00	26.66	53.33	2.76
Fuel expenditure will be avoided in drone utilization.	100.00	0.00	0.00	5.00
Less chemical spray and low wastage leads to cut down unnecessary expenditure	63.33	23.33	13.33	4.15
Best alternative to overcome labor scarcity.	43.33	35.00	21.66	3.68
If used in flowering and fruiting stages of the crop, it may leads to damage.	46.66	20.00	33.33	3.55
Drone Technology may not reduce the cost of spraying.	60.00	10.00	30	3.83

Table-3 Distribution of farmers perception based on Physical and Social perception on technology (n=60)

Physical and Social	Agree	Neutral	Disagree	MWS
Reduces stress to arrange manual labour.	26.66	38.33	35.00	3.18
Drone utilization gives confidence to adopt other Precision farming technologies.	48.33	18.33	33.33	3.56
Enhances social status among peer group.	13.33	26.66	60.00	2.55
Drone utilization helps to reduce drudgery.	100.00	0.00	0.00	5.00
Avoids exposure of farmers to harmful chemicals while spraying.	86.66	13.33	0.00	4.76

Where, Theoretical Field Capacity (TFC) is the rate of field coverage of an implement that would be obtained if the machine was performing its function 100 per cent of the time at the rated forward speed and always covered 100 per cent of its width. Effective Field Capacity (EFC) is the actual average rate of coverage by the machine. It includes the effects of time lost in the field and failure to utilize the full width of the drone.

Results and Discussion

Farmer's perception towards UAV (Drone) Technology on Agro-chemical spraying

Results from [Table-1] indicates that 93.33 percent of farmers with a mean score of 4.76 believed drones will cover a wider area in a shorter amount of time (5-10 minutes/acre), followed by spraying immediately after irrigation (4.60), more useful in horticulture crops such as citrus, mango, sapota, etc. than field crops (4.35 mean score), useful in tall and dense crops such as maize, jowar, and redgram (4.33 mean score).

However, 68.33 per cent of the farmers opined that drifting of the drone spray to the adjacent fields and 53.33per cent of the farmers opined that recommended dose of chemicals is not done with drone spraying.

[Table-2], shows that 100 percent of farmers agreed that drones will avoid fuel costs with a 5.0 mean score, followed by less chemical spray and low wastage (4.15). However, 60 per cent farmers expressed that drone spraying may not reduce the cost of spraying (3.83). It may be due to the acreage covered by one man day cost (Rs. 500/day) is three times more than the drone spraying cost per acre(Rs 500/ac) which is leading to higher cost than the conventional method. It was also considered as best alternative to overcome labour scarcity in future by 43.33 per cent of the respondents. On the other end, 53.33 per cent of farmers disagreed regarding the reduction in labour costs compared to conventional methods of spraying. It may be due to lack of drone operators in the area.

[Table-3], the data from table indicates that hundred per cent of the farmers agreed that drone utilization helps in reduction of drudgery followed by (86.6%) exposure of farmers to harmful chemicals while spraying is avoided, these findings are cope with the results of Desale *et al.* (2019) [12]. Forty-eight per cent of the respondents opined that drone utilization gives confidence to adopt other precision farming technologies.

Field performance of UAV Technology in spraying

Drone field performance in various horticultural and agricultural crops that were sprayed more than twice were assessed in accordance with Kepner, *et al.*, (1987) criteria. [Table-4] shows that compared to other field crops, chickpeas obtained highest field efficiency of 44.85%, which may be due to less turnover losses and lesser height than other field crops which lead to increase the forward speed of the drone. Horticultural crops like mango and citrus (12-year orchard) displayed lowest field efficiency of 39.24%. Spraying at each plant while rotating at a slower forward speed resulted in lower field efficiency than field crops, which may be related to increased turnover loss. These findings concur with the results reported by Rathod, (2021) [13].

Table-4 Field level performance of UAV Technology in different field and horticultural crops (n=60)

Particulars	Paddy	Chikpea	Maize/ Redgram	Citrus/ Mango
Optimum height of spraying, (m)	2.05	2.30	2.50	2.50
Forward speed, (m/s)	4.03	4.05	4.200	3.20
Average time taken (min./ha)	18.6	18.30	18.00	26.25
Width of spray, (m)	5.10	5.00	5.4	5.05
Theoretical field capacity, (ha/hr)	7.39	7.29	8.16	5.81
Effective field capacity,(ha/hr)	3.84	3.87	3.33	2.28
Field efficiency (%)	43.57	44.85	40.8	39.24

Conclusion

Drones have great potential to transform Indian agriculture. Future technological advancements are anticipated to make drone manufacture economically feasible. It is firmly shielding farmers from the negative effects of chemicals while facilitating a quick and easy task for them. Due to the arduous labour required in farming, modern rural youth are not drawn to it. The potential use of drones may captivate young people and inspire them to pursue agriculture as an enterprise. Drones can also be used for applications including broadcasting of seed, weed and disease localization, soil property determination, vegetation detection, and the creation of precise elevation models in future. Though field efficiency of drone spraying is less in horticulture crops, when compared to field crops, the overall efficiency will be more with drone spraying in horticulture crops when compared to manual sprayings. Due to higher cost of spraying farmers are not coming forward. Drone facility should be created at the village level on Custom hiring model with minimum cost and the government should enhance pilot training facilities and related service facilities to increase the adoption of drone technology. The farmers in our country cannot afford for pay the technological interventions. They need the government need to subsidize the cost of the technology to enable farmers move towards precision technologies, which would significantly enhance the farm productivity. Therefore, drones may become part and parcel of agriculture in the future by helping farmers in managing their fields and resources in a better and more sustainable way.

Application of research: Field level performance of drone evaluated through those farmers were taken up more than two times with drone technology

Research Category: Drone Technology in Agriculture

Abbreviations: EFC-Effective Field Capacity, FE-Field efficiency, MWS-Mean Wight Score, TFC-Theoretical Field Capacity, UAV-Unmanned Arial Vehicle

Acknowledgement / Funding: Authors are thankful to Shri Hanumantharaya Educational and Charitable Society, ICAR-Krishi Vigyan Kendra, Yagantipalle, 518124, India

****Principal Investigator or Chairperson of research: E Ravi Goud**
Institute: ICAR-Krishi Vigyan Kendra, Yagantipalle, 518124, India
Research project name or number: Research station study

Author Contributions: All authors equally contributed

Author statement: All authors read, reviewed, agreed and approved the final manuscript. Note-All authors agreed that- Written informed consent was obtained from all participants prior to publish / enrolment

Study area / Sample Collection: Nandyal, Andhra Pradesh

Cultivar / Variety / Breed name: Horticulture crops

Conflict of Interest: None declared

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.
Ethical Committee Approval Number: Nil

References

[1] Food and Agriculture Organization of the United Nations (2018) *FAOSTAT : Crops. Retrieved from*: http://www.fao.org /faostat/en/#data/QC
[2] Gartland K.M.A. and Gartland J.S. (2018) *Euro Biotech Journal*, 2(1), 1-9.
[3] Shaw, Karan & Vimalkumar R. (2020) *International Journal of Engineering Research & Technology*, 9(5), 1181-1185.
[4] Yallappa D., Veerangouda M., Maski D., Palled V. & Bheemanna M. (2017) *IEEE Global Humanitarian Technology Conference*, 1-7.
[5] Nonami K. (2007) *Journal of system Design and Dynamics*, 1(2), 120-128.
[6] Dutta G. and Goswami P. (2020) *International Journal of Chemical Studies*, SP-8(5), 181-187.
[7] Holownicki R. (2000) *Journal of Agricultural Engineering Research*, 77(2),129-136.
[8] Gavali P.B. and Kalashetty S.S. (2018) *International journal of engineering science invention*, 7(9), 1-5.
[9] Chitra G.A., Muraleedharan Vr., Swaminathan T. and Veeraraghavan D. (2006) *International Journal of Occupational and Environmental Health*, 12(3), 228-233.
[10] Jaideep H. (2017) *The Indian farmers falling prey to pesticide. BBC News,https://www.bbc.com/news/world-asia-india-41510730*.
[11] Kepner R.A., Barrner R. & Barger E.L. (1987) *Principal of Farm machinery, CBC publishing company. New Delhi, India*, 1-72.
[12] Desale R., Chougule, A., Choudhari M., Borhade V. & Teli S. (2019) *International Journal for Science and Advance research in Technology*, 5(4), 79-82.
[13] Rathod P.D. (2021) M.Sc. Thesis. Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, M.S., India.