Developing Drone Based Potato Crop Management Technologies

Application of unmanned aerial vehicle, commonly known as drone has immense potential in agriculture. ICAR- Central Potato Research Institute has started work on 'Development of drone-based potato crop management technologies' at its regional stations of Modipuram and Jalandhar since 2020 in collaboration with Bayer Crop Science Ltd. India and General Aeronautics Pvt. Ltd. having defined objective of developing précised crop management technologies for potato crop. Project activity was started in first year after getting necessary permissions from the Director General of Civil Aviation (DGCA), Ministry of Civil Aviation (MoCA), and local administration. But the scenario changed in second crop season due to revolutionary liberal policy shift of Government of India for promoting the use of drone in agriculture. Trials at two locations for two years on agro-chemicals (fungicides, insecticides and weedicide) spray using drone has clearly demonstrated advantage of increased precision, and efficiency with lower water requirement, reduced environmental hazards and no phytotoxicity in potato crop.

Frequent application of pesticides is required to achieve targeted productivity in potato crop in a short span of 90-110 days as the crop is susceptible for large number of insect-pests and diseases. In first step, recommended doses of pesticides were evaluated with ultra-low volume of water in drone spray for phytotoxicity, uniformity of spray and possible drift. A multirotor UAV (General Aeronautics, India) with six propellers was used to spray pesticides and weedicides. On-board UAV had a battery pack (27 Ah), RF (Radio frequency)-based transceiver, microcontroller, GPS and safety sensors for communication and flight parameters. Its ultra-low volume spraying system consisted of a liquid chemical storage tank of 20-liter capacity and four centrifugal atomizing nozzles had overall swath of 4 meter. Ground control software was used for navigation and control of operational parameters. UAV flight was configured to maintain a speed of 12.6 km/h with flow rate of 60 l/h at an altitude of 2 m above ground level. With this speed and swath this drone sprayed approximately 1.26 ha area in about 15 minutes. Geotags of the field were configured in the UAV using the GPS to navigate the system on predefined path.

In first year, drone application of eight pesticides was done in an area of 1.2 ha and observations on penetration efficiency, pesticide drift, plant coverage and phytotoxicity were recorded using standard protocols. Uniform and better penetration with fine droplet coverage at all three levels (top, middle & bottom) of potato plants was observed in drone spray;

whereas, lesser penetration at lower level of plants and bigger droplet size were observed in tractor mounted and battery operated knapsack sprayers. None of the pesticides exhibited any phytotoxicity in potato crop. Spray drift was observed in 5 m buffer zone, but the quantity was negligible. Similarly, fourteen pesticides were evaluated separately and or as tank mix in second crop season and results were encouraging as better chemical penetration and no phytotoxicity was observed. Drift by drone was also in safer limits.

Drone-based spraying had several advantages i.e. exact estimation of land area saved chemicals, very less water requirement per unit area as only 20 l per ha was sufficient as compared to 500-750 l water needed in conventional spraying, and spray efficiency as time taken to cover one ha was less than 15 minutes. Initial findings of current studies indicated that drone-based application of pesticides is safe and can be used on large scale for effective management of potato pests and diseases. These results can easily be converted into recommendations for potato crop following the SOPs developed by MOA & FW as released on 21 December, 2021.

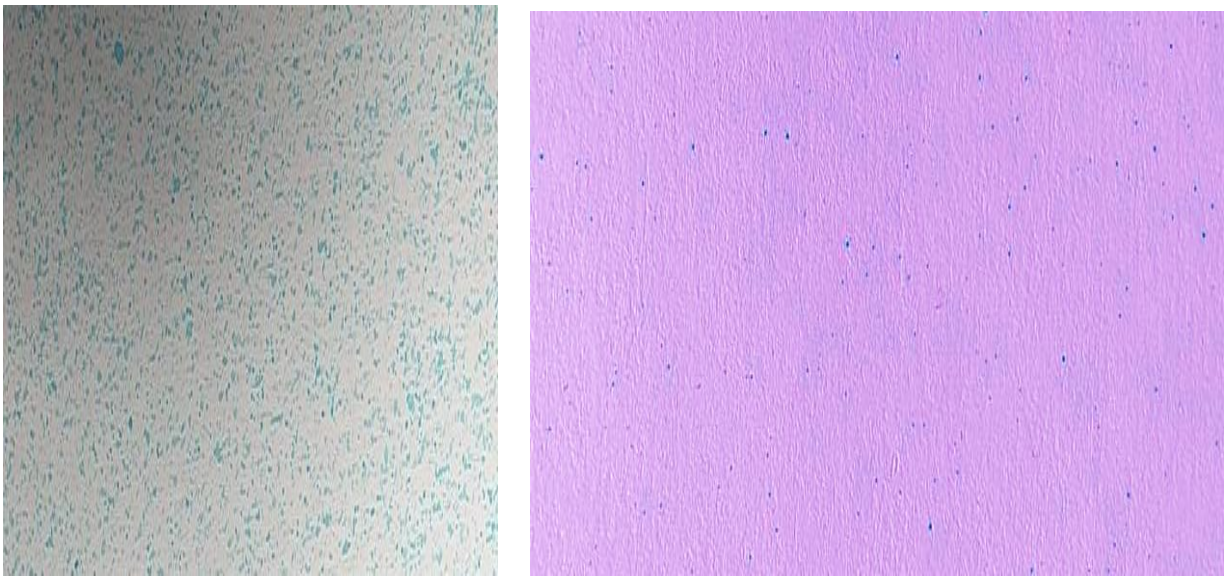
Institute has also started an awareness programme about drone technologies from this year and a potato farmer's meet was organized by ICAR- CPRI- Bayer Crop Science and General Aeronautics on 06 December 2021 at ICAR- CPRI RS Jalandhar. Around 30 progressive potato growers of Punjab participated in the event and showed great enthusiasm for this cutting-edge technology. Another workshop on similar line was also organized on 21 January, 2022 at ICAR-CPRI RS, Modipuram for scientists- progressive farmers and entrepreneurs to showcase the usefulness of this technology. More than 40 persons participated in this event. Results of two potato crop seasons were shared with all stakeholders by ICAR-CPRI. General Aeronautics highlighted the use of drones, its latest innovations and commercialization of this technology. Bayer Crop Science explained about the recommended agro-chemicals suitable for potato crop and drone technology. Live demonstrations of efficient autonomous variable rate spray technology were carried out by General Aeronautics on 2 ha potato crop at both locations.

The farmers and entrepreneurs present on both the occasion enthusiastically participated in these events and were impressed by the precision and efficiency of this technology. Use of drone technology in Indian agriculture particularly in potato crop is really a great leap towards smart farming of future and ICAR- CPRI is also going to work for soil mapping, nutritional and water deficiencies, identification and control of potato pests and diseases, and yield forecasting.

Fig.1: Hexacopter UAV used in study

Fig.2: Preparing chemical for drone spray

Fig.3. Droplet distribution (A) Drone spray; (B) Tractor mounted spray; (C) Battery operated knapsack spray



Spray droplet distribution within treatment

Spray droplet distribution in buffer zone

Fig.4. Drift assessment in drone spray

Fig.5. Participants in drone technology workshop at Jalandhar

Fig.6. Participants in drone technology workshop at Modipuram