AIRCRAFT ACCIDENT REPORT AND EXECUTIVE SUMMARY

				Reference:		CA18/2/3/10100	
Aircraft Registration	ZS-XPC	**Date of Accident**		8 January 2022		**Time of Accident**	0730Z
Type of Aircraft	Air Tractor AT-502A			**Type of Operation**		Aerial Work (Part 137)	
Pilot-in-command Licence Type	Commercial Pilot Licence			**Age**	61	**Licence Valid**	Yes
Pilot-in-command Flying Experience		**Total Flying Hours**		13 314.7		**Hours on Type**	2 887.4
Last Point of Departure	Farm Elandsfontein, Fochville District, Gauteng Province						
Next Point of Intended Landing	Farm Elandsfontein, Fochville District, Gauteng Province						
Damage to Aircraft	Minor						

Location of the accident site with reference to easily defined geographical points (GPS readings if possible)

Farm Elandsfontein (GPS co-ordinates: 26°36'18.35" South 027°33'54.22" East), elevation 5 015 feet (ft)

Meteorological Information	Surface wind; 090°/8 knots, temperature; 17°C, visibility; CAVOK						
Number of People On-board	1 + 0	**Number of People Injured**	0	**Number of People Killed**	0	**Other (On Ground)**	1

Synopsis

On Saturday morning, 8 January 2022, a pilot on-board an Air Tractor AT-502A aircraft with registration ZS-XPC was engaged in a crop-spraying detail at Elandsfontein farm in Fochville District, Gauteng province. The flight was conducted under visual meteorological conditions by day and under the provisions of Part 137 of the Civil Aviation Regulations (CAR) 2011 as amended.

The pilot was the sole occupant on-board the aircraft. A person on the ground was filming the flight whilst the pilot was spraying the chemical herbicide over a maize field. The person was positioned approximately 100 metres (m) from where the maize field ends, and roughly in line with the spray path of the aircraft. As the pilot banked to the left to position the aircraft for the next spray run, the left-wing tip struck the left leg and the upper left arm of the person filming the flight. The farmer took the seriously injured person to the hospital in Potchefstroom.

Probable Cause

During a low-level turn to the left whilst the pilot was manoeuvring the aircraft for the next spray run, the left-wing tip struck a person on the ground who was filming the flight.

SRP date	9 May 2023	Publication date	10 May 2023

Occurrence Details

Reference Number	**:** CA18/2/3/10100
Occurrence Category	**:** Accident (Category 1)
Type of Operation	**:** Aerial Work Operations / Agricultural (Part 137)
Name of Operator	**:** Private Operation
Aircraft Registration	**:** ZS-XPC
Aircraft Make and Model	**:** Air Tractor, AT-502A
Nationality	**:** South African
Place	**:** Farm Elandsfontein, Fochville District, Gauteng Province
Date and Time	**:** 8 January 2022 at 0730Z
Injuries	**:** One person on the ground was seriously injured.
Damage	**:** Minor

Purpose of the Investigation

In terms of Regulation 12.03.1 of the Civil Aviation Regulations (CAR) 2011, this report was compiled in the interest of the promotion of aviation safety and the reduction of the risk of aviation accidents or incidents and not to apportion blame or liability.

All times given in this report are Co-ordinated Universal Time (UTC) and will be denoted by (Z). South African Standard Time is UTC plus 2 hours.

Investigation Process

The Accident and Incident Investigations Division (AIID) was notified of the occurrence on 8 January 2022. The occurrence was classified as an accident according to the CAR 2011 Part 12 and ICAO STD Annex 13 definitions.

Notes:

1. *Whenever the following words are mentioned in this report, they shall mean the following:*
   Accident — this investigated accident
   Aircraft — the Air Tractor AT502A involved in this accident
   Investigation — the investigation into the circumstances of this accident
   Pilot — the pilot involved in this accident
   Report — this accident report

2. *Photos and figures used in this report were taken from different sources and may have been adjusted from the original for the sole purpose of improving clarity of the report. Modifications to images used in this report were limited to cropping, magnification, file compression; or enhancement of colour, brightness, contrast; or addition of text boxes, arrows, or lines.*

Disclaimer

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Abbreviation	Description
°	Degrees
°C	Degrees Celsius
AGL	Above Ground Level
AIID	Accident and Incident Investigations Division
AMO	Aircraft Maintenance Organisation
AMSL	Above Mean Sea Level
AOC	Air Operating Certificate
CAR	Civil Aviation Regulations
CAVOK	Clouds and Visibility OK
C of A	Certificate of Airworthiness
C of R	Certificate of Registration
CPL	Commercial Pilot Licence
CRS	Certificate of Release to Service
CVR	Cockpit Voice Recorder
FAPS	Potchefstroom Aerodrome (ICAO code)
FDR	Flight Data Recorder
ft	Feet
GPS	Global Positioning System
hPa	Hectopascal
km	Kilometres
kt	Knots
m	Metres
METAR	Meteorological Aerodrome Report
MHz	Megahertz
PIC	Pilot in Command
QNH	Barometric Pressure Adjusted to Sea Level
TBO	Time Between Overhaul
SACAA	South African Civil Aviation Authority
SANS	South Africa National Standards
SAWS	South African Weather Service
UTC	Universal Co-ordinated Time
VHF	Very High Frequency
VFR	Visual Flight Rules
Z	Zulu (Term for Universal Co-ordinated Time - Zero Hours Greenwich)

1. FACTUAL INFORMATION

1.1 History of Flight

1.1.1 On Saturday morning, 8 January 2022, a pilot on-board an Air Tractor AT-502A aircraft with registration ZS-XPC took off from Potchefstroom Aerodrome (FAPS) to perform a crop-spraying detail on Elandsfontein farm in Fochville District, Gauteng province. The farmer had procured the services of an agricultural aircraft because his maize field was waterlogged due to heavy rains in the area and, thus, could not conduct spray work using his conventional farm equipment (tractors and sprayers).

1.1.2 The aircraft took off from FAPS with a full hopper load of chemical herbicide prepared specifically for the crop-spraying detail. Upon arrival at the farm, the pilot sprayed a section of the maize field until it was depleted before he landed on the gravel runway on the farm. The gravel runway was also specifically prepared for the aircraft. After landing the aircraft, the hopper tank was filled again with another load of the chemical herbicide. The farmer's family took photographs of the aircraft and spraying operation between the first and the second load of the spray run on the farm. The pilot did not give a safety briefing to the farmer and his family. The pilot assumed that the family would stay at the loading zone, which was well clear of the aircraft's manoeuvring area. Page 17 of the South African National Standard (SANS) 10118 (2011, Edition 3.1) states the following on aerial application of pesticides, *"the protection of observers is the responsibility of the sponsor, and aerial application operations shall not be started until the sponsor has checked that observers are suitably protected."* Note: the sponsor is the farmer in this instance.

1.1.3 Whilst the pilot was engaged in crop-spraying, the family was joined by another person who was accompanied to the field to watch the aircraft, approximately 100 to 130 metres (m) north of where the maize field ended (and facing the aircraft which was flying towards their direction). The person was filming the flight using his cellular phone. In an interview, he stated that he was standing upright as the pilot was spraying the maize crops and flying towards him; he then decided to bend forward whilst still filming, and later got down on his haunches. *This was evident in the video footage as the aircraft was approaching low towards his direction*. He further stated that when the aircraft was approximately 25m away from his position, he laid on his back all the while filming the aircraft with his cellular phone now positioned between his knees, which were bent. The family member who accompanied the person was on his right side in a hunched position at that stage. (*In sub-heading 1.12 of this report, several screen shots from the video footage are presented as Figures 5 to 9, which will provide the sequence of the flight events.)*

1.1.4 The pilot stated that he was performing crop-spraying and was re-entering the field to commence his next spray run. As he made a turn for the next spray run, he noticed a vehicle

that was parked approximately 100m away from the field, as well as people running towards the vehicle. He stated that the vehicle was not there during his previous spray runs. As he continued with the crop-spraying operation, the people drifted out of his line of sight. The pilot stated that he was under the impression that the people were still by the vehicle, which was clear of his spray line (path). The pilot then entered his next spray run, flying in a northerly direction. As he pulled out of the spray run, he felt a soft thump and thought he had struck a bird. As he completed his turn and lined-up for the next spray run, he noticed people running towards the end of the previous spray line he had just completed. He then called the farmer on his cellular phone to enquire about people running to the spray line and was informed that he had struck a person on the ground. The pilot stated that due to the prevailing weather conditions and the type of chemical being sprayed, he was required to fly at a very low altitude, which caused the pull out to be lower than what it would have been if the spray application was performed at a higher altitude. According to the pilot, he was flying at approximately 250 kilometres per hour (km/h). The visibility from the cockpit was limited to just over the hopper tank and the engine compartment; moreover, because he was flying uphill, he was unable to see the people in front of his flight path after completing the spray run.

1.1.5 The person who was filming the flight was seriously injured when the left-wing tip of the aircraft struck him below his left knee. His left upper arm also bruised as the wing tip made contact with it. The farmer drove the seriously injured person to the hospital in Potchefstroom, about 50km from the farm. The person underwent surgery on the same afternoon.

1.1.6 The accident occurred during day light at Elandsfontein farm at Global Positioning System (GPS) co-ordinates determined to be 26°36'18.35" South, 027°33'54.22" East, at an elevation of 5 015 feet (ft).

Figure 1: The yellow pin shows the position of the accident site. (Source: Google Earth)

1.2 Injuries to Persons

Injuries	Pilot	Crew	Pass.	Total On-board	Other
Fatal	-	-	-		-
Serious	-	-	-	-	1
Minor	-	-	-	-	-
None	1	-	-	1	-
Total	**1**	**-**	**-**	**1**	**1**

Note: Other, means people on the ground.

1.3 Damage to Aircraft

1.3.1 There aircraft sustained damage to the left-wing tip.

Figure 2: Damage to the left-wing tip of the aircraft.

1.4 Other Damage

1.4.1 None.

1.5 Personnel Information

1.5.1 Pilot-in-command (PIC)

Nationality	South African	Gender	Male	Age	61
Licence Type	Commercial Pilot Licence				
Licence Valid	Yes	Type Endorsed	Yes		
Ratings	Instrument, Safety Pilot, Tug Pilot, Agricultural Rating				
Medical Expiry Date	28 February 2022 (Class 1)				
Restrictions	Corrective lenses for defective distant, intermediate and near vision. Hypertension Protocol				
SANS 10118:2011 Pilot Requirement	Pest Control Operator Certificate				
Previous Accidents	On 27 February 1989 whilst flying a Cessna 188, ZS-KRR, there was loss of engine power during a late part of the take-off; the pilot dumped the chemical load, but the aircraft collided with a fence at the end of the runway which caused the speed to decay further. The aircraft stalled at low altitude, impacted terrain with one wing low, cartwheeled and ended up in an inverted position.				

	On 7 November 1995 whilst flying an Air Tractor AT-502B, ZS-NIA, the pilot, after take-off, encountered a strong tail wind on rotation and dumped the load at full power; the aircraft pitched up 90° and impacted the ground tail first.

Note: Previous accidents refer to past accidents the pilot was involved in, when relevant to this accident.

Flying Experience:

Total Hours	13 314.7
Total Past 90 Days	210.9
Total on Type Past 90 Days	210.9
Total on Type	2 887.4

1.6 Aircraft Information

1.6.1 Air Tractor AT-502A (Source: www.airtractor.com)

The Air Tractor AT-502A is an agricultural aircraft with an all-metal low-wing monoplane structure and tail dragger configuration. The aircraft is equipped with a chemical hopper tank with a capacity of 1 893 litres (500 US gallons) located between the cockpit and the engine firewall. The aircraft is fitted with a Pratt & Whitney PT6A-140AG turboprop engine, which produces 647 kilowatts (kW) (867 shaft horsepower) paired with a four-blade Hartzell propeller.

Figure 3: The ZS-XPC aircraft.

Airframe:

Manufacturer/Model	Air Tractor Incorporated / AT-502A (XP)	
Serial Number	502A-3241	
Year of Manufacture	2020	
Total Airframe Hours (at time of accident)	809.9	
Last Inspection (Hours & Date)	752.5	19 December 2021
Airframe Hours Since Last Inspection	57.4	
C of A (issue date & expiry date)	29 September 2020	30 September 2022
C of R (issue date) (Present Owner)	7 September 2020	
Operating Category	Standard Restricted (Aeroplane)	
Type of Fuel Used	Jet A1	
MTOW	4 754kg (10 480lbs)	
Previous Accidents	None	

Note: Previous accidents refer to past accidents the aircraft was involved in, when relevant to this accident.

Engine:

Manufacturer/Model	Pratt & Whitney PT6A-140AG
Serial Number	PCE-VB0081
Hours Since New	809.9
Hours Since Overhaul	TBO not reached

Propeller:

Manufacturer/Model	Hartzell HC-B4TN-3C
Serial Number	CDA5864
Hours Since New	809.9
Hours Since Overhaul	TBO not reached

1.7 Meteorological Information

1.7.1 The weather information entered in the table below was obtained from the pilot questionnaire (SACAA form CA 12-03).

Wind Direction	090°	Wind Speed	8 kt	Visibility	+ 10 km
Temperature	17°C	Cloud Cover	2 octas	Cloud Base	8 000ft
Dew Point	Unknown	QNH	1024hPa		

1.8 Aids to Navigation

1.8.1 The aircraft was equipped with standard navigational equipment as approved by the Regulator (SACAA). There were no recorded defects with the navigational equipment prior to the accident.

1.9 Communication

1.9.1 The aircraft was equipped with a standard communication system as approved by the Regulator. There were no recorded defects with the communication system prior to the accident.

1.10 Aerodrome Information

1.10.1 The aircraft landed on Elandsfontein farm where a gravel runway was specifically prepared for the aircraft . The runway is 1 000m long and 12m wide.

Figure 4: The gravel runway used by the pilot at the farm.

1.11 Flight Recorders

1.11.1 The aircraft was neither equipped with a flight data recorder (FDR) or a cockpit voice recorder (CVR), nor was it required in accordance with the regulation.

1.11.2 The aircraft was equipped with the Ag-Nav precision navigation line guidance system which is used by pilots to follow the correct spray lines. The uses of the Ag-Nav precision navigation line guidance system include spraying agricultural fields, controlling mosquitoes or for survey purposes.

1.11.3 In Figure 5, the maize field earmarked to be sprayed is highlighted in purple. The first field that was sprayed was the 25.39-hectare field which was adjacent to the runway; it is highlighted in dark blue.

1.11.4 The Ag-Nav spray pattern in Figure 6 shows the first field that was sprayed (referenced in 1.11.3).

Figure 5: The area map of the farm with the runway and maize fields highlighted in blue.

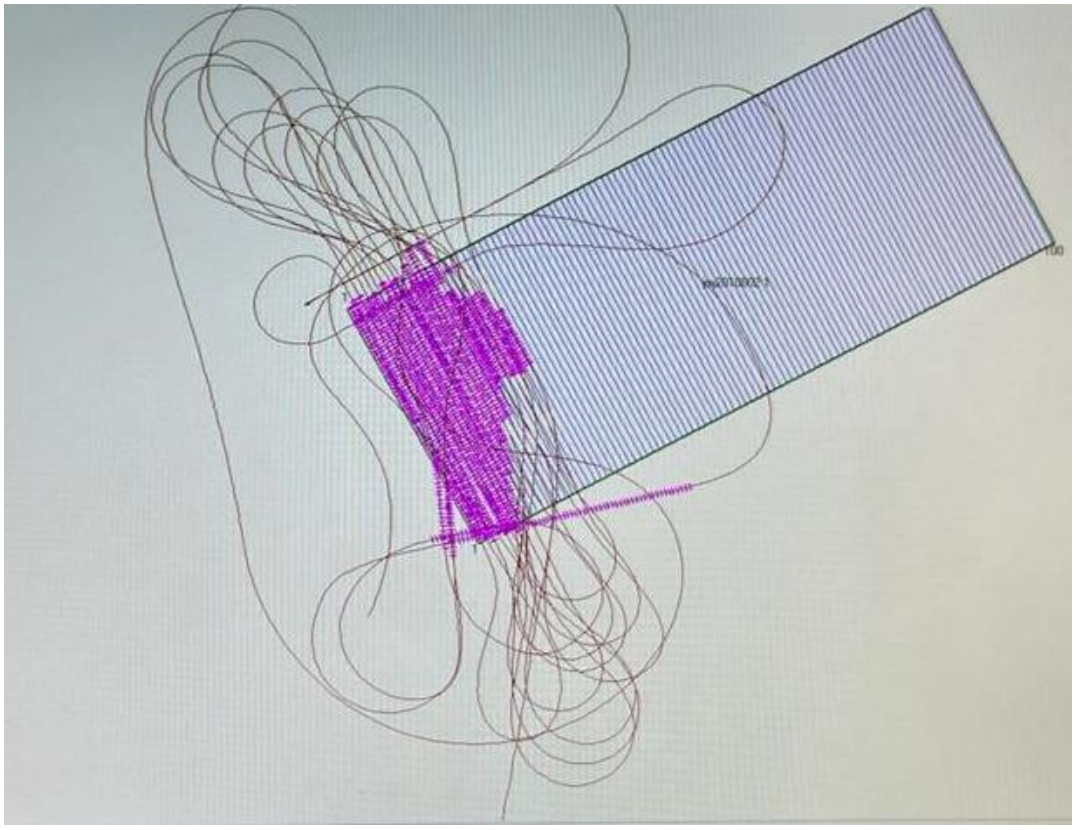

Figure 6: The flight profile from the Ag-Nav system that was flown when the accident occurred.

1.12 Wreckage and Impact Information

1.12.1 The left-wing tip fairing, which is manufactured from fibreglass, had minor damage when the wing tip struck the left leg of the person on the ground. The person was positioned approximtely 100 to 130m from the end of the maize field that was being sprayed. The vegetation consisted of different types of grass, which varied in height from the ground (level) to approximately 80 centimetres (cm) in height. Figure 13 shows the height in relation to a four-wheel drive vehicle. In the same figure, the maize field that was being sprayed is visible beyond the vehicle.

Figure 7: The position where the two people were standing when filming the flight.

Figure 8: The enlarged view of the aircraft from the video footage taken by the person whilst in an upright position.

Figure 9: In this frame, the person filming is bending forward.

Figure 10: In this frame, the person is on his haunches.

Figure 11: In this frame, the wing of the aircraft is visible with the person laying on his back.

Figure 12: A small piece of fibreglass from the left-wing tip fairing found at the scene.

Figure 13: The view of the grassland. This is where the person was standing when filming the aircraft.

1.13 Medical and Pathological Information

1.13.1 Not applicable.

1.14 Fire

1.14.1 There was no evidence of a pre- or post-impact fire.

1.15 Survival Aspects

1.15.1 The accident was survivable.

1.15.2 The person on the ground who was seriously injured was taken to the hospital in Potchefstroom where he underwent surgery on the same day. The hospital is approximately 50km from the farm.

1.16 Tests and Research

1.16.1 None.

1.17 Organisational and Management Information

1.17.1 The famer required the services of an agricultural aircraft to spray his maize field as his agricultural machinery could not be used for this task due to the waterlogged field. The aircraft was not endorsed on the Air Operating Certificate (AOC) at the time of the accident as per the provisions of Part 137.01.3 of the CAR 2011 as well as the South African Civil Aviation Technical Standards (SA-CATS) 137. The content applicable to the Regulations is attached to this report as Appendix A.

1.17.2 The last maintenance inspection that was carried out on the aircraft prior to the accident flight was certified on 18 December 2021 at 752.5 airframe hours by an approved aircraft maintenance organisation (AMO). The aircraft was flown a further 57.4 hours post-inspection.

1.18 Additional Information

The SANS 10118 (2011, Edition 3.1): The aerial application of pesticides (Source: South African Bureau of Standards [Standards Division])
https://ia801900.us.archive.org/20/items/za.sans.10118.2011/za.sans.10118.2011.html

Definition of agricultural aviation
"[G]eneric term for operations in which aircraft are used for dusting or spraying crops, plantations, forests, water and any other area, to control crop pests, plant diseases and weeds, for fertilization, the spreading of trace elements, plant defoliation, plant growth regulates and similar purposes"

Definition of Sponsor: "farmer or organisation commissioning the application of the pesticide."

Requirements for the Sponsor

11.1 General

11.1.1 The sponsor shall be aware of the relevant warnings, such as pesticide precautions, resistance, use restrictions, direction for use, and of the advantages and limitations of the recommended pesticide as set out on the approved label (see foreword) of the product.

11.1.2 The final decision on which pesticide, aerial application company, aircraft and pilot to be used shall rest with the sponsor. He shall not be obliged to use any of those recommended by the chemical distributor or registration holder (or both). He shall ensure that the pilot and aircraft involved in the spraying operation meet all legal requirements (such as being a registered pilot with a current Pest Control Operator Certificate and using a registered and approved aircraft).

11.1.3 The sponsor shall decide whether or not the application shall be carried out, for example, in case of imminent rain.

11.1.4 The sponsor shall be aware of nearby susceptible crops or sensitive areas (within 5 km of field(s) to be sprayed) and shall ensure that the aerial spraying operator is informed accordingly.

11.2 Warnings

Public in the immediate vicinity shall be informed about the spray activity in the area by notices posted at relevant sites. The warnings on the registration holder's label, as approved by the relevant authority, shall be adhered to.

11.3 Landing place

If a sponsor does not have a landing place on his farm that complies with the requirements of clause 6, he shall ensure that he has access to, and permission to use, a suitable landing place.

11.4 Protection

The protection of observers is the responsibility of the sponsor, and aerial application operations shall not be started until the sponsor has checked that observers are suitably protected.

11.5 Effectiveness of treatment

The sponsor shall ensure that aerial application is undertaken at the correct stage of crop or pest development (whichever is applicable), to ensure crop safety and effectiveness of treatment.

11.6 Additional responsibilities

The sponsor shall ensure that:

a. *the written instructions are conveyed to the aerial application company contracted to apply the pesticide and the sponsor shall ensure that the aerial application company and pilot comply with all the requirements to operate as such;*
b. *the pilot is aware of the exact size of the land to be treated and susceptible neighbouring crops;*
c. *water to be used for mixing the pesticide is analysed periodically to ensure that sufficient water of acceptable hardness and known pH value is available;*
d. *the pesticide is delivered at the landing place in time;*

e. *sufficient water for washing purposes is available at the operating area;*

f. *inanimate markers are supplied;*

g. *deleted by amendment No. 1;*

h. *farm animals and unauthorized persons are kept away from areas where pesticides are stacked and from the relevant areas during mixing, loading and application, until the landing place has been cleaned up after application operations;*

i. *all field labour and their belongings (for example lunch boxes, clothing and water containers) are removed from the spray area to a sufficient distance so as not to be affected by the spray operation;*

j. *all pedestrian traffic through the area is halted;*

k. *all workers on the farm shall inform their relatives and people living with them not to enter the sprayed land(s) until the re-entry period recommended by the registration holder's label is approved by the relevant authority (see foreword);*

l. *under no circumstances shall harvesting or grazing be permitted immediately and within the withholding period after the application of a pesticide; and*

m. *surplus and empty containers of pesticides shall be safely disposed of in accordance with SANS 10206.*

11.7 Attendance of spraying operation

The sponsor or his representative shall be present to observe the quality of, and conditions during, the application, and to sign the pilot's spray logbook after application to confirm the accuracy of the pilot's information of the conditions that existed during the spray operation."

1.18.1 Extract from Part 137 of the CAR 2011

Operation over non-populous area

137.02.6 *Notwithstanding the provisions of Part 91, a pilot of an aircraft engaged in an agricultural or fire-fighting operation may, during or for the purposes of the operation, fly at any altitude and at any distance from an obstruction if—*

(a) *the operation is not conducted over a populous area;*

(b) *the operation is conducted without creating a hazard to persons or property on the ground; and*

(c) *the altitude and distance for all approaches, turns and departures are necessary for the operation.*

1.18.2 Flight Patterns During Aerial Application

(Source: Aerial Applicators Manual, Pg. 88, 89 [Written by: Patrick J O'Connor-Marer, PhD])

"One flight pattern for aerial application is the adjacent swath or back and forth pattern, applying swaths over the target in straight, parallel lines. In areas that are too rugged for uniform altitude and speed, follow the contours of the slopes during application passes. In hilly terrain, or where hills or mountains confine the application area and do not permit contour flying, make all passes in one direction, down slope. Upslope spraying can be dangerous. Usually, the racetrack pattern is the most energy efficient. This pattern maximizes application time and lessens the time required for turns. It also allows time for the spray to settle, reducing the chance of flying through it. This pattern often minimizes pilot fatigue. Whether flying a racetrack or back and forth pattern, it is important to start and stop spraying at the right time when entering or leaving the field. Starting too soon or stopping too late causes spray to be applied to off target areas. Starting too late or stopping too soon may result in improper coverage to field ends."

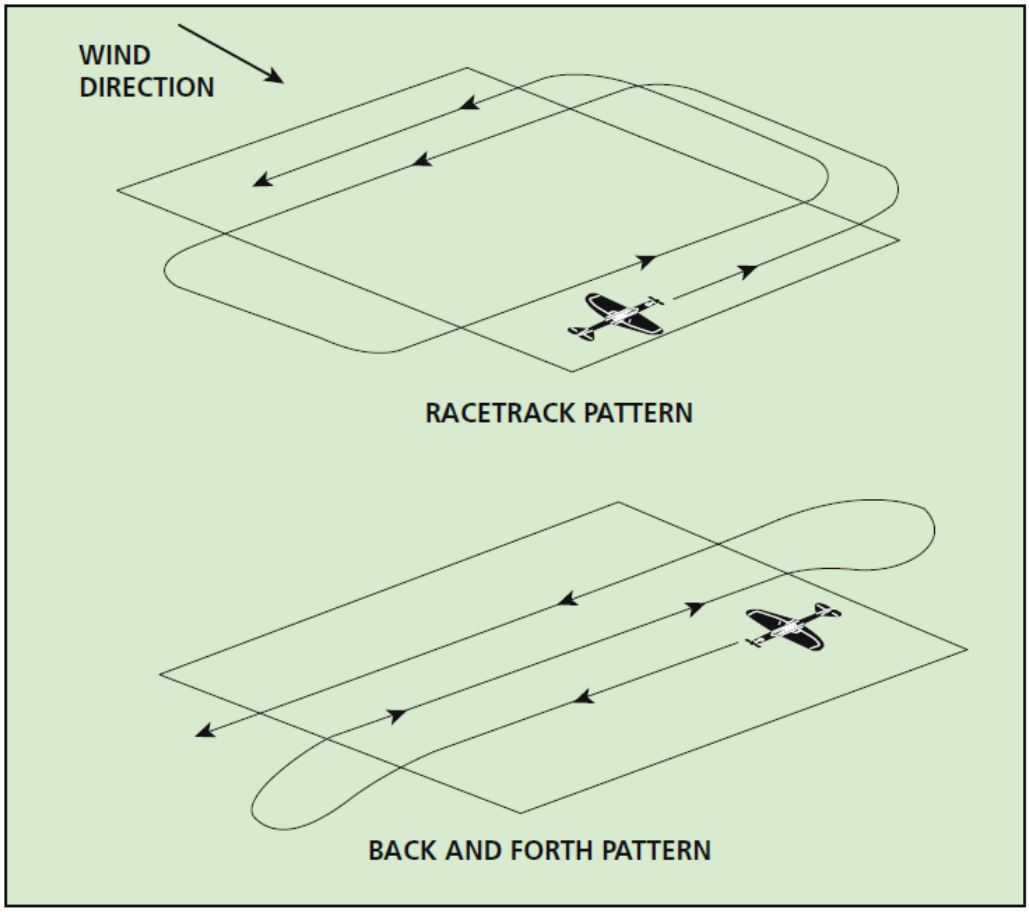

Diagram 1: Back-and-forth pattern.

The Turnaround

"When flying back and forth or racetrack swaths in a fixed-wing aircraft, be careful when executing turnarounds. This is because a pull up followed by a turn renders a low-speed,

high-drag condition that could lead to a stall. Poorly executed turnarounds cause a considerable number of aerial application accidents. In addition, poorly executed turnarounds do not allow time for proper positioning for the next swath and may result in uneven applications. When completing a swath run, pull up, clear any obstructions, and level off before starting a turnaround. After pulling up, make a wide enough initial turn downwind that will provide sufficient room for a smooth turn around. Then level off for several seconds before completing the turn back into the treatment area. This provides ample time for the turn, prevents crowding the turn, and reduces the chance of a stall spin. Many factors affect the number of seconds needed in level flight before completing the turn, including swath spacing, speed and direction of the wind, air density, altitude, and the load weight, power, and manoeuvrability of the aircraft. Attentiveness to these factors and careful timing during this final stage of the turnaround are the keys to avoiding the hazards associated with fast or intricate manoeuvring. Always complete the turnaround before dropping in over any obstructions on the next swath run approach.

Avoid snapping reversal or wing overturns. When making a turn by going upwind first requires more space and time to complete the turn. Any turning while dispensing a spray or granules distorts the distribution pattern resulting in uneven application of the pesticide. Whenever possible, avoid making turnarounds over residences and other buildings, penned poultry or livestock, livestock watering places, ponds, reservoirs, or other bodies of water. Avoiding these areas mitigates or minimizes nuisance from noise or sight of the aircraft."

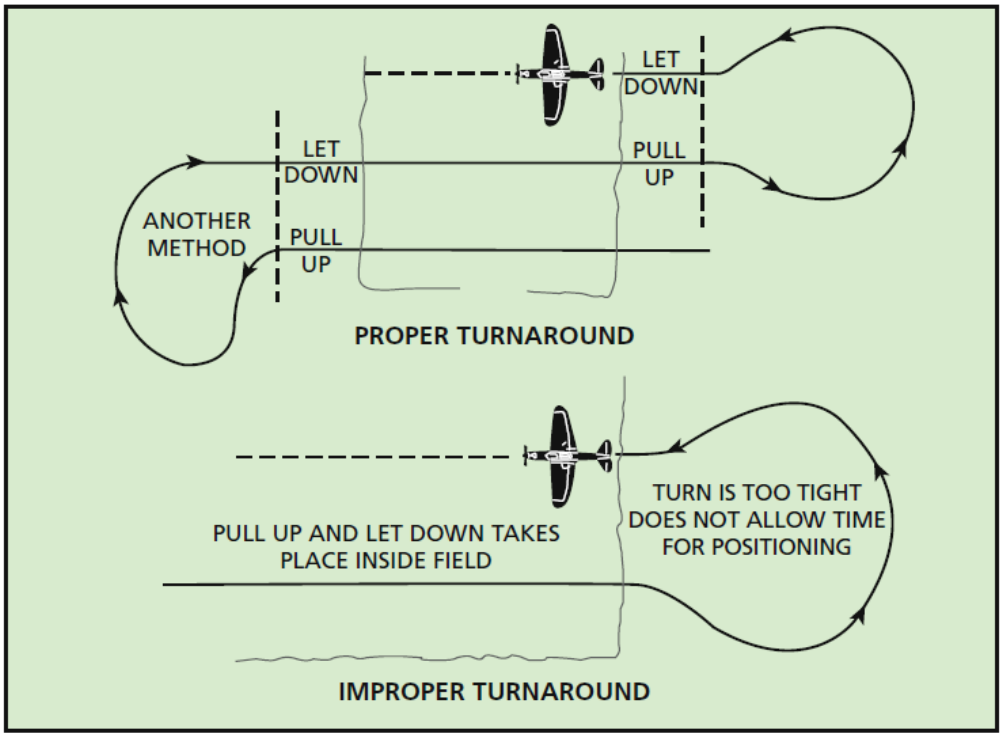

Diagram 2: Improper turnaround.

1.18.3 Flying the Flight Profile

On Thursday, 13 January 2022, the investigator and the pilot flew on a Cessna 182 aircraft over the same maize field the pilot was spraying at the time of the accident. The purpose of the flight was to gain an understanding of the view from the cockpit when flying at a similar height to what the pilot was flying at whilst spraying the field. For the duration of this flight, the investigator's attention was on the cockpit. Figures 14 to 16 present the view of the flight from inside the aircraft. The maize field had an upslope in a north-westerly direction, which was the direction where the two people were positioned. It should be noted that the Air Tractor AT-502A aircraft that the pilot was flying during the crop-spraying detail had a considerably longer nose than the Cessna 182 — the hopper tank is located in front of the cockpit, and the engine and the propeller are positioned in front of the hopper tank.

Figure 14: View over the maize field in a north-westerly direction on a Cessna 182 aircraft.

Figure 15: The aircraft approaches the end of the maize field.

Figure 16: The end of the maize field with the runway ahead (dirt strip).

1.18.4 Video Footage

Four video clips with the aircraft in-flight conducting spray work were made available to the investigator. One of the videos was filmed at another farm, the other three videos were filmed on the day of the accident whilst the pilot was crop-spraying on the farm in question. Two of the videos were taken before the injured person arrived at the farm. In both these video clips, the farmer and his family are standing next to a parked vehicle (white in colour). The person in the still video footage (Figure 17) is the farmer. The aircraft is also visible in the background. The fourth video clip was taken by the injured person.

Figure 17: The still video footage shows the aircraft, vehicle and farmer.

1.19 Useful or Effective Investigation Techniques

1.19.1 No new methods were used.

2. ANALYSIS

2.1 General

From the available evidence, the following analysis was made with respect to this accident. This shall not be read as apportioning blame or liability to any organisation or individual.

2.2 Analysis

2.2.1 Due to heavy rains in the area, the farmer procured an aircraft to spray his crops as his conventional farming equipment usually used for this operation was unsuitable as the land

was waterlogged. The use of the crop-spraying aircraft was not a commonly used method on this farm. The farmer had to prepare a runway on which the aircraft was to land.

All the maize fields were earmarked for crop-spraying. This information was provided to the pilot in advance so he could plan for his spray profile. The pilot took off from FAPS with a full hopper load of chemical herbicide. He, therefore, was able to immediately commence with the spraying detail when he joined overhead the farm. After the first load was emptied, the pilot landed on the prepared gravel runway where the hopper tank was refilled by ground personnel. During this period, the pilot had a conversation with the farmer and his family.

The pilot then took off and continued with the crop-spraying detail. The aircraft instrument panel featured an Ag-Nav system (precision navigation system for spraying agricultural fields) which provided the pilot with an accurate spray pattern. The pilot opted to fly the back-and-forth pattern, moving in a north-westerly and south-easterly directions.

Whilst the pilot was crop-spraying, another person arrived at the farm. Without consultation with the farmer, the person and one family member entered the manoeuvring field, approximately 100 to 130m north-west to where the maize field ended to film the flight. The injured person was not familiar with crop-spraying aircraft and the dangers associated with it, which is not only limited to low flying.

According to the SANS 10118 (2011, Edition 3.1): The aerial application of pesticides page 17 states, *"the protection of observers is the responsibility of the sponsor, and aerial application operations shall not be started until the sponsor has checked that observers are suitably protected."*

Aerial Application

Aerial application or crop-dusting aircraft operations are inherently dangerous as most of the flying is conducted at low level (minimum flight heights). Not only does the aircraft pose a hazard to people on the ground, but also the chemicals that are being sprayed which could be harmful when people come into contact with the substance, especially when the spray application drifts or perhaps if there is a leak on the dispersal system.

To minimise the risk of such incidents/accidents, government agencies established regulations and guidelines for crop-spraying operations; South Africa has the SANS 10118: The aerial application of pesticides. It is important that requirements such as minimum heights, maximum wind speeds and protective clothing for ground personnel are addressed. It is also important that all role players work together to ensure that crop-spraying is conducted safely and responsibly. Once the pilot is airborne, he does not have any control over the movement of people or livestock on the ground that might encroach on the manoeuvring area of the aircraft, which could restrict or increase the risk of operation. The

onus remain with the sponsor (in this instance, the farmer) to ensure that operational safety requirements are complied with on the ground.

2.2.2 Conclusion

(i) The crop-spraying aircraft was never commissioned on this farm before the accident. Therefore, the farmer was most probably not familiar with the safety provisions and the requirements of the SANS 10118 (2011, Edition 3.1): The aerial application of pesticides.

(ii) From the video clips that were made available to the investigator, it was evident that the farmer and his family were standing next to a white vehicle, which made the location of the people on the ground much easier for the pilot to see whilst manoeuvring the aircraft.

(iii) The person (who was injured) arrived at the spray zone after the aircraft was airborne. He did not spend time in the area to acquaint himself with the aircraft and its flight path before he made a decision to enter the field to film the flight.

(iv) The two people who entered the field were not familiar with aviation regulations and the dangers associated with crop-spraying operations.

(v) The maize field sloped downhill from where the two people were positioned. Therefore, the pilot would have been able to see the two people in the field within his manoeuvring area if he were looking ahead.

(vi) The pilot stated that he did not see the two people on the ground whilst crop-spraying.

(vii) The pilot was not made aware by the people on the ground via his cellular phone that two people had entered the field in his manoeuvring area to film the flight.

(viii) While manoeuvring the aircraft for the next spray run, the pilot executed a left turn, which caused the left-wing tip of the aircraft to be close to the ground. Due to lack of video footage evidence, it could not be determined if this type of manoeuvre was the norm for the pilot on the day or if it was a once-off turn close to the ground.

(ix) The injured person and the family member entered the active manoeuvring area of the aircraft that was engaged in low-level operation. There were no safety measures in place on the ground to prevent their actions, hence, they were allowed to enter the danger area associated with high-risk flying which could likely result in serious consequences.

3. CONCLUSION

3.1 General

From the available evidence, the following findings, causes and contributing factors were made with respect to this accident. These shall not be read as apportioning blame or liability to any organisation or individual.

To serve the objective of this investigation, the following sections are included in the conclusion heading:

- **Findings —** are statements of all significant conditions, events, or circumstances in this accident. The findings are significant steps in this accident sequence, but they are not always causal or indicate deficiencies.
- **Causes —** are actions, omissions, events, conditions, or a combination thereof, which led to this accident.
- **Contributing factors —** are actions, omissions, events, conditions or a combination thereof, which, if eliminated, avoided or absent, would have reduced the probability of the accident occurring, or would have mitigated the severity of the consequences of the accident. The identification of contributing factors does not imply the assignment of fault or the determination of administrative, civil, or criminal liability.

3.2 Findings

<u>The pilot</u>

3.2.1 The pilot had a Commercial Pilot Licence (CPL). According to his logbook, he had flown a total of 13 314.7 hours, of which 2 887.4 hours were on the aircraft type. The pilot had a valid agricultural rating as well as a pest control operator's certificate as per the provisions of Part 137.01.2 of the CAR.

3.2.2 The pilot was issued a valid Class 1 aviation medical certificate on 19 August 2021 with an expiry date of 28 February 2022.

3.2.3 The pilot stated that he did not see the two people on the ground whilst manoeuvring the aircraft for his next spray run.

3.2.4 The pilot did not give the farmer and his family a safety briefing whilst the aircraft was being refilled with the chemical herbicide on the ground.

The aircraft

3.2.5 The aircraft was issued a Certificate of Airworthiness (C of A) on 17 September 2020 with an expiry date of 30 September 2022.

3.2.6 The aircraft was issued a Certificate of Registration (C of R) on 7 September 2020.

3.2.7 The last maintenance inspection carried out on the aircraft prior to the accident flight was certified on 18 December 2021 at 752.5 airframe hours. The aircraft had accumulated 57.4 airframe hours since the said inspection.

3.2.8 The Certificate of Release to Service (CRS) was issued on 18 December 2021 with an expiry date of 18 December 2022 or at 852.5 hours of flight time, whichever occurs first.

3.2.9 The left-wing tip (a removeable fibreglass fairing) sustained minor damage (see Figure 3). It was repaired by the AMO.

Operation

3.2.10 The aircraft was not endorsed on an AOC at the time of the accident. The flight was conducted under the provisions of Part 137 of the CAR (2011).

3.2.11 According to the SANS 10118 (2011, Edition 3.1): The aerial application of pesticides, page 17 states, *"the protection of observers is the responsibility of the sponsor, and aerial application operations shall not be started until the sponsor has checked that observers are suitably protected. Under 11.6 Additional responsibilities (j), it further state that all pedestrian traffic through the area is halted."*

Environment

3.2.12 Fine weather conditions prevailed at the time of the flight. The weather was not considered to have had any bearing on this accident.

The sponsor

3.2.13 As per the SANS 10118 (2011, Edition 3.1) The aerial application of pesticides, the protection of observers (people on the ground) is the responsibility of the sponsor (in this case, the farmer).

3.2.14 At no time did the farmer intervene by indicating to the two people who entered the field that the area they had selected to film the flight was within the manoeuvring area of the aircraft and, therefore, a danger zone.

Injured person on the ground

3.2.15 The person (family friend) arrived at the crop-spraying zone after the crop-spraying operation had already commenced. The aircraft was airborne for some time.

3.2.16 The person did not acquaint himself with the dangers associated with the operation before he and one of the family member entered the field and put themselves in a vulnerable position within the manoeuvring area of the aircraft.

3.2.17 The person on the ground filming the flight was seriously injured when the left-wing tip of the aircraft struck his left leg below his knee and his left upper arm as the aircraft banked to the left.

3.2.18 The person was admitted to the hospital in Potchefstroom and surgery was performed to his left leg on the same day.

3.3 Probable Cause

3.3.1 During a low-level turn to the left whilst the pilot was manoeuvring the aircraft for the next spray run, the left-wing tip struck a person on the ground who was filming the flight.

3.4 Contributory Factors

3.4.1 There was no proper assessment made by the person from the time he arrived at the spray zone until he positioned himself in the field in the manoeuvring area of the aircraft.

3.4.2 The person did not keep a safe distance from the flight path, he positioned himself within the manoeuvring area of the aircraft.

3.4.3 At no time did the farmer intervene by informing the two people about the safety implications of their actions.

3.4.4 The two people were not familiar with the aviation agricultural practices, or the danger associated with crop-spraying aircraft.

3.4.5 The maize field that was being sprayed sloped downhill from where the person was filming. The pilot, therefore, would only have been able to see the people on the ground if he were actively looking ahead when he was fairly close to them.

3.4.6 The pilot executed the left turn at low level, and the left-wing tip of the aircraft was close to the ground.

3.4.7 The farmer was most probably not familiar with the safety requirements prescribed in the SANS 10118 (2011, Edition 3.1) The aerial application of pesticides.

4. SAFETY RECOMMENDATIONS

4.1 General

The safety recommendations listed in this report are proposed according to paragraph 6.8 of Annex 13 to the Convention on International Civil Aviation and are based on the conclusions listed in heading 3 of this report. The AIID expects that all safety issues identified by the investigation are addressed by the receiving States and organisations.

4.2 Safety Messages

4.2.1 It is recommended that a safety briefing be held by the pilot before any spray work is conducted on a farm where there are people on the ground (all people) who may not be familiar with the dangers associated with this type of operation. The farmer / farm manager / / sponsor should take responsibility for the safety of the people, especially those who may arrive after the briefing has concluded and where the spray detail had already commenced (that is, when the aircraft is airborne).

4.2.2 It is recommended that all sponsors (farm owners, farm managers, etc.) acquaint themselves with the guidance material as contained in the South African Bureau of Standards (SABS) document, South African National Standard 10118 (2011, Edition 3.1) The aerial application of pesticides.

4.3 Safety Recommendation

4.3.1 It is recommended to the Director of Civil Aviation that the Regulator revise/amend Part 137 of the CAR (2011) regarding agricultural spraying operations by referring to the South African Bureau of Standards document — South African National Standard 10118 (2011, Edition 3.1) The aerial application of pesticides. This document contains essential information which addresses the sponsor on the safety of the people on the ground whilst the aircraft is airborne/actively engaged in the crop-spraying detail. It has been noted that Part 137 has no guidelines on the safety of the people on the ground when the aircraft is airborne, as well as does not state where responsibility lies with regard to terrain/people. Crop-spraying is associated with a high-risk operation which requires intense concentration. Also, the pilot is not able to keep a lookout at all times for any sudden hazards or people who may enter the manoeuvring area on the ground.

5. APPENDICES

5.1 Appendix A (Part 137.01.3 of the Civil Aviation Regulations)

This report is issued by:
Accident and Incident Investigations Division
South African Civil Aviation Authority
Republic of South Africa

Appendix A

Requirements for commercial agricultural and commercial fire-fighting operations

137.01.3 *(1) An operator of an aircraft engaged in commercial agricultural or commercial fire-fighting operations, shall not operate the aircraft unless such operator is the holder of a valid—*

(a) licence issued in terms of the Air Services Licensing Act, 1990, (Act No. 115 of 1990), or the International Air Services Act, 1993 (Act No. 60 of 1993); and

(b) an air operator certificate and operations specifications issued in terms of Part 96, Part 121, Part 127, Part 128 or Part 135, as the case may be, subject to the exception prescribed in Document SA-CATS 137; or

(c) a FOP issued in terms of the International Air Services Act, 1993.

(2) All commercial agricultural and commercial fire-fighting operations shall be conducted in terms of the procedures defined in the operator's operations manual.

(3) The procedures contained in the operations manual shall meet the applicable requirements prescribed in Document SA-CATS 137.

SA-CATS-137

Part 137.01.3 REQUIREMENTS FOR COMMERCIAL AGRICULTURAL AND COMMERCIAL FIRE-FIGHTING OPERATIONS

1. AOC requirements

   The operator of an aircraft engaged in commercial agricultural or commercial fire-fighting operations, shall not operate the aircraft unless such operator is the holder of an AOC issued in accordance with the applicable provisions of the CAR: Provided that the operator does not need to complete a statement of compliance document."