Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

AVIATION INVESTIGATION REPORT
A12C0084

CONTROLLED FLIGHT INTO TERRAIN

SUNRISE HELICOPTERS INCORPORATED
BELL 206B C-GUIK
ANGUSVILLE, MANITOBA, 6 NM SW
05 JULY 2012

Canada

The Transportation Safety Board of Canada (TSB) investigated this occurrence for the purpose of advancing transportation safety. It is not the function of the Board to assign fault or determine civil or criminal liability.

Aviation Investigation Report

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Report Number A12C0084

Summary

The Sunrise Helicopters Incorporated Bell 206B Jet Ranger (registration C-GUIK, serial number 1908) was completing an application flight spraying fungicide near Angusville, Manitoba. During a spray run, the helicopter descended and contacted the crop, and then struck the ground. The helicopter came to rest on its side, with substantial damage. The pilot was taken to hospital with serious injuries. The accident occurred during daylight hours at 1045 Central Daylight Time, in visual meteorological conditions. There was no post-crash fire. The 406-MHz emergency locator transmitter activated on impact.

Ce rapport est également disponible en français.

Factual Information

History of the Flight

The pilot had ferried the aircraft from North Bay, Ontario, to Russell, Manitoba, arriving on 30 June 2012 to conduct agricultural spraying in the surrounding area. A specially modified tanker truck was also deployed to Russell. The truck had been modified to carry both chemicals and aviation fuel, and had a landing platform that had been constructed on top for the boom-equipped helicopter.

During spraying operations, the truck was parked into wind at the area to be sprayed. The pilot landed multiple times on the platform, where a company ground handler dispensed both fuel and chemicals to the helicopter. The proximity of the truck to the spraying operation reduced transit time, and the raised platform reduced the chance of snagging the spray booms during take-off and landing.

Spraying operations began on 01 July 2012, and were conducted each day until the day of the accident on 04 July 2012. The flights were flown at 15 feet above ground level (agl), at 80 mph. On at least 2 occasions in the previous days, the pilot had flown the helicopter into the crop and returned to the truck with crop stuck in the helicopter's skid gear.

On 04 July 2012, spraying operations began around 0830. [1] At about 1030, the helicopter was flying in a northerly direction, towards slowly rising terrain. The helicopter contacted the crop, then struck the ground. The pilot was able to get out of the wreckage and walk back to the tanker truck. The accident occurred behind a ridgeline between the truck and the helicopter, and was not observed by the ground handler. There was no supervisor or other company personnel on site.

Weather

There are no official weather reports issued for Angusville. The reported weather at 1100 for Brandon, Manitoba, which is 70 miles to the southeast of the accident site, was a northwesterly wind at 12 knots gusting to 17 knots, visibility 15 statute miles (sm), and no cloud below 5100 feet agl. The temperature was 21°C, and the altimeter was 29.74 inches of mercury.

Weather at the accident site was similar. Photographs taken immediately after the accident indicated that the weather at the site was clear. The winds were measured at the site as spraying operations were conducted, and were reportedly 18 km / h gusting to 22 km / h, but within the company's limit for spraying operations of 25 km / h.

Helicopter

Records indicate that the helicopter was certified, equipped, and maintained in accordance with existing regulations and approved procedures. The weight and center of gravity were within

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[1] All times are Central Daylight Time (Coordinated Universal Time minus 5 hours).

the prescribed limits, and there was sufficient fuel to complete the flight. No technical difficulties with the aircraft were noted before the event. The helicopter had undergone a 100-hour inspection on 28 June 2012, approximately 33 hours before the occurrence.

An agricultural navigation (AGNAV) system display was mounted on the right side of the instrument panel, directly in the pilot's line of sight. The AGNAV system is a global positioning system (GPS) used to assist in establishing an accurate spray pattern; it has an optional light bar that is designed to be mounted externally. The company had this equipment, but had discontinued use of the lights, since the AGNAV display provided more useful information and had to be viewed. The lights provided only left- or right-of-track information, and were found to be an additional distraction from terrain-clearance tasks.

Site and Wreckage Examination

The field was located in an area of gently rolling terrain, and was about 1 mile square, or 640 acres. The chemical was being applied to a 2- to 3-feet–high green wheat crop, which filled the field. In appearance, the crop was like a uniform carpet, except for a small brown patch in a low-lying drainage area. Tracks, made as the helicopter's skids had entered the wheat in rising terrain, led to the wreckage (Photo 1). The tracks indicated that the helicopter had descended into the drainage area and then started up the slope out of the drainage area. In the direction of flight, there were no vertical objects or other discernible features to assist in track alignment.

The helicopter struck the ground in a slight right-skid−low attitude. The right spray boom contacted the wheat, followed closely by the left spray boom. The nose of the helicopter and the Simplex belly tank struck the ground along with the main rotor blades, leaving 8 distinct rotor-blade marks in the ground and crop to the right side of the wreckage trail. The helicopter flipped and became airborne, tearing the main transmission, rotor assembly and tail section free from the helicopter. The helicopter came to rest on its left side, approximately 225 feet from the initial crop contact.

The wreckage was examined on site. There was no indication of any malfunction before or during the flight. All breaks in the control systems were overload in nature, and were attributed to the collision and impact forces. Damage to the main rotor blades and engine drive shaft was consistent with normal engine power being supplied to the main rotor blades at impact.

At the time of the accident, the pilot was wearing a helmet and was restrained by a 4-point harness.

Pilot Information

The pilot was certified and qualified for the flight in accordance with existing regulations. The pilot had been hired by Sunrise Helicopters Incorporated in June 2010, after graduation from an 8-month pilot training program with a flight training school in North Bay, Ontario. Upon graduation, the pilot had approximately 102 hours of helicopter flight time, obtained primarily on the Robinson R22 and R44 helicopters. For the first 2 years of employment with Sunrise Helicopters Inc., the pilot worked as a chemical loader for spraying operations.

Training

In May 2012, the pilot was provided with 10.4 hours of flight training on the Bell 206B. In June 2012, the pilot was trained by the company's chief pilot in forestry spraying operations, using the Bell 206B. The spray training provided was all conducted at a height of 10 feet above the trees, which provided references for alignment and altitude control. No training was conducted over terrain similar to that of the accident flight, which comprised a uniform surface with little contrast and with no vertical references for height judgment or alignment. The spraying flight-training time was 12.1 hours, which was completed on 26 June 2012. About 11 hours of the pilot's training involved the use of a GPS called the AGNAV. The pilot was trained to use the AGNAV for assistance in establishing an accurate spray pattern, but was to select and use outside visual references for alignment. Before using the AGNAV in the helicopter, AGNAV training was given in a classroom setting, and additional practical training was given on a wheeled, ground training device.

The company aerial application procedures manual contains the following information: [2]

AGNAV GPS SYSTEM PROCEDURES

WHEN TO OPERATE THE AGNAV

- The AGNAV should be tested and set up for the next job prior to starting the job.
- Any adjustments to the AGNAV shall be carried out on the flight deck or ground prior to lifting off or when a safe altitude is reached; to ensure the aircraft is in no danger of making contact with any hazards or obstacles in the vicinity.

WHEN TO LOOK AT THE AGNAV

- The AGNAV is to **assist** in creating straighter lines and good coverage of the area being sprayed. This means proper attention should be given to using the area's features and proper planning to carry out the majority of the spraying.
- One shall not give majority of the attention to the AGNAV.
- One should develop a scanning method where one scans the AGNAV, gauges, air photo (if required), and the outside.
- Majority of the time should be used to look outside the window; look where you are going and **FLY THE AIRCRAFT.**
- It should only be seconds that one looks at the AGNAV Screen.

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2 *Aerial Application Procedures* (July 10, 2012), AGNAV GPS System Procedures

WARNING!

Looking at the AGNAV screen too much or for too long will take attention away from flying the aircraft, which can result in injury or loss of life.

Two days after this training, the pilot flew C-GUIK to Russell to begin spraying operations in the vicinity. When the accident occurred, the pilot's total flying time was about 200 hours, with about 120 hours of experience on the accident type.

Records indicated that over the previous 4 days, the pilot had flown approximately 22 hours and worked a total of about 30 hours. On the evening before the accident, the pilot had finished flying around 1916.

Risk During Low-level Helicopter Operation

Spraying operations at very low level are characterized by high workload and a higher risk of significant consequences of distraction or lapses in attention than in non-low–level helicopter operation. [3] Task saturation can occur before the pilot recognizes a dangerous situation. The United States Armed Forces has developed and formalized low-level flight awareness concepts, which it uses together with low-altitude flight training in the application of those concepts, to mitigate the potential for task saturation and terrain contact in low-level flight. The following information is summarized from a flight-training instruction publication produced by the US Naval Air Training Command. [4]

These low-level flight awareness concepts divide tasks into 2 categories: terrain-clearance tasks and mission tasks. Terrain-clearance tasks involve any mental or physical effort expended to avoid hitting the ground, and include 4 sub-tasks:

- Aerodynamic control of the aircraft: the process of maintaining the aircraft within its flight envelope.
- Flight path: the process of assessing and modifying the aircraft flight path in elevation and azimuth.
- Altitude control: the process of assessing and modifying the aircraft altitude in relation to the terrain.
- Time control: involves knowing when and for how long flight path and altitude control can be "ignored." Time control is considered the key to proper task

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[3] The company experienced 2 other accidents in 2012 related to application operations. Transportation Safety Board (TSB) occurrence file A12C0083 involved a Bell 206B flight, during which a spray boom contacted the ground on take-off from the mixing-truck platform, which led to substantial damage resulting from the subsequent autorotation, but no injuries. TSB occurrence file A12O0162 involved a Bell 206B that experienced a collision with terrain while turning at the end of a swath application run, resulting in substantial damage to the helicopter, but no injuries to the pilot. Both occurrences involved other pilots and aircraft than the ones in this occurrence.

[4] United States Navy, CNATRA P-12 (New 07-07) – *Flight Training Instruction: Low Altitude Awareness Training* (LAAT), Naval Air Training Command, Naval Air Station Corpus Christi, Texas, 2007

management. It is also considered the hardest task to learn and the most difficult to control.

Mission tasks comprise all remaining activities, and are divided into 2 sub-tasks:

- Critical tasks: functions needing immediate attention in order to successfully complete the mission.
- Non-critical tasks: functions that can be addressed in a more flexible time window.

Training in very low-level flight must emphasize terrain-clearance tasks and not concentrate on mission tasks. When mission tasks have precedence over terrain-clearance tasks, ground impact can result. Training should emphasize the development of a sense of mission cross-check time, which is the time available for critical and non-critical tasks after terrain-clearance tasks have been completed.

Time-to-Impact Calculations

Tables 1 and 2 indicate the time to impact (TTI) that would be experienced at several flight path angle (FPA) deviations. [5] Case 1 represents the accident flight condition, and Case 2 represents the flight conditions under which the pilot was trained and flew for forestry spraying operations.

Table 1. Case 1 (80 mph, 15 feet altitude above terrain)

FPA (degrees)	TTI (seconds)
−5.00	1.5
−2.00	3.6
−1.00	7.3
−0.75	9.7
−0.50	14.0
−0.25	29.0

Table 2. Case 2 (80 mph, 10 feet altitude above terrain)

FPA (degrees)	TTI (seconds)
−5.00	1.0
−2.00	2.4
−1.00	4.8
−0.75	6.5
−0.50	9.7
−0.25	19.4

[5] Calculations provided by the TSB Laboratory

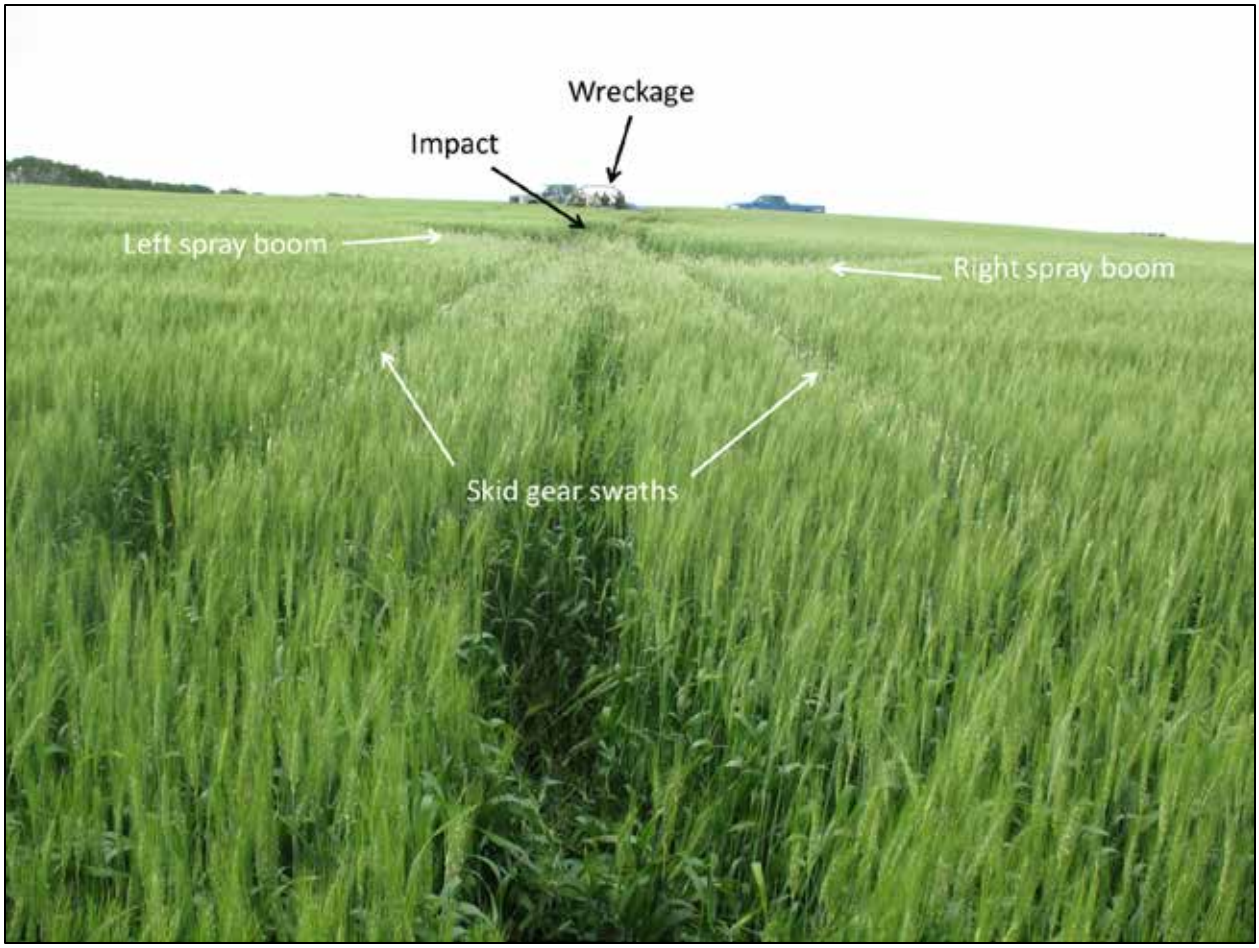

Photo 1. Wreckage site

Height-Depth Perception

When flying over desert, snow, water, or other areas of poor contrast, pilots may experience difficulty in judging their height above terrain. This difficulty is due to lack of visual references. The *US Army Field Manual* states: [6]

> HEIGHT-DEPTH PERCEPTION ILLUSION
>
> 9-27. The height-depth perception illusion is due to a lack of sufficient visual cues and causes an aircrew member to lose depth perception. Flying over an area devoid of visual references—such as desert, snow, or water—will deprive the aircrew member of his perception of height. The aviator, misjudging the aircraft's true altitude, may fly the aircraft dangerously low in reference to the ground or other obstacles above the ground. Flight in an area where visibility is restricted by fog, smoke, or haze can produce the same illusion.

[6] *US Army Field Manual* No. 3-04.301(1-301): Aeromedical Training for Flight Personnel, Chapter 9 – Spatial Disorientation

Analysis

There was no indication that an aircraft system malfunction contributed to this occurrence. As a result, this analysis will focus on the operational and environmental factors that contributed to the occurrence and the injuries sustained by the pilot.

The pilot's flight training in spraying operations and in use of the agricultural navigation (AGNAV) system was conducted in forestry spraying, at a height of 10 feet above the trees. While the height of 10 feet could be considered to be of greater risk than 15 feet, the outside heading references reduced the need to spend time checking the AGNAV, and the textures of the tree canopies provided adequate outside references for altitude control and terrain avoidance. Thus, the pilot developed a sense of mission cross-check time based on that training environment.

The 2 tables specifying time to impact (TTI) for several flight path angles (FPAs) indicate that there is about a 50% gain in TTI by flying at 15 feet above the terrain vice 10 feet. However, that statement assumes that the pilot's estimate of height above terrain is accurate. The field in which the spraying operations were conducted comprised a uniform surface with little contrast and with no vertical references with which to judge height accurately. In addition, the gusty winds likely contributed to the workload of maintaining a stable height. The lack of outside heading references likely increased the pilot's attention to the AGNAV display, and reduced the time available for terrain-clearance activities. The pilot had flown into the crop on 2 occasions before the accident flight, indicating that the pilot was having difficulty with these 2 judgments. Consequently, it is likely that the pilot's unrealistic appreciation of mission cross-check time and of height judgment combined and led to terrain impact.

In addition to the lack of training over similar terrain, the pilot's overall flying experience was less than 200 hours in total. This matching of an inexperienced pilot to an intense, high pilot-workload, high-risk spraying operation at 15 feet above ground level (agl) placed unrealistic expectations on the pilot to complete the operation.

Additionally, the pilot was deployed to high-risk spraying operations without supervision or mentoring by experienced company staff. Consequently, safety was left to the discretion of the pilot, who attempted to complete the operation despite having experienced 2 near-collisions with terrain.

Even though the pilot suffered serious injuries, the fact that the pilot was wearing a helmet and utilized the 4-point harnesses likely enhanced the survivability of the impact.

Findings

Findings as to Causes and Contributing Factors

1. The experience level of the pilot was low for the complexity of the assigned task, and placed unrealistic expectations on the pilot to complete the operation successfully.

2. The uniform nature of the crop, combined with the absence of vertical references, made the judgment of height above the terrain difficult.

3. There was no supervision of the pilot at Angusville.

4. The pilot continued to conduct spraying operations despite having flown into the crop on 2 occasions.

5. The pilot's judgment of height above the ground and concept of time available to attend to mission tasks likely led to the collision with terrain.

Other Findings

1. The use of a helmet and the 4-point harnesses likely enhanced the survivability of the impact.

Safety Action

Safety Action Taken

Sunrise Helicopters Incorporated

Sunrise Helicopters Incorporated has hired a risk manager to reduce risk, and a formal risk assessment of hazards is now required for every contract.

All spray pilots employed by the company must have a minimum of 2000 hours of total flight time.

The experience of the pilot will be matched to the demands of the contract.

A mentorship program has been initiated, and a senior pilot will be on site to supervise a junior pilot for the first 50 hours of spraying operations. If the pilot's performance is considered satisfactory, the pilot will be released to deploy without direct supervision.

Training now includes operations at 15 feet above ground level (agl) over the airport field. Spray training will be done with new pilots at both forestry and agricultural operational heights above ground.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 29 May 2023. It was officially released on 21 June 2013.

Visit the Transportation Safety Board's website (www.bst-tsb.gc.ca) for information about the Transportation Safety Board and its products and services. You will also find the Watchlist, which identifies the transportation safety issues that pose the greatest risk to Canadians. In each case, the TSB has found that actions taken to date are inadequate, and that industry and regulators need to take additional concrete measures to eliminate the risks.