

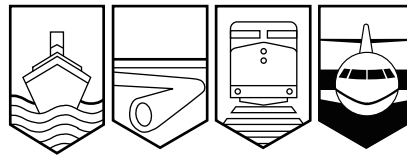
Transportation Safety Board
of Canada



Bureau de la sécurité des transports
du Canada

AVIATION INVESTIGATION REPORT

A01A0100



LOSS OF CONTROL - COLLISION WITH TERRAIN

CANADIAN HELICOPTERS

BELL HELICOPTER TEXTRON 206B C-GLRA

JUNIPER STATION, NEW BRUNSWICK 42 Km NE

13 AUGUST 2001

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.

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Summary

Canadian Helicopter's B206B helicopter, serial number 1753, C-GLRA, after being fuelled and loaded with herbicide, was lifting off from a logging road on a herbicide spraying mission when the aircraft yawed to the right. When loss of control was experienced, the helicopter was going through translational lift at an airspeed of less than 30 miles per hour and at an altitude of approximately 10 feet above ground level. To the right side of the take-off path was a grove of trees approximately 20 feet tall. As the helicopter was yawing to the right and heading toward these trees, the pilot pulled in collective pitch to get over the top of the trees. After clearing the trees, the pilot lowered the collective and pushed the cyclic forward. The helicopter had rotated two or three times, and the pilot had just about regained control, when the tail rotor contacted a lone spruce tree in a clear-cut area. The tail-rotor gear box separated from its mounts, resulting in complete loss of heading control. The aircraft then struck the ground and rolled over on its left side. The aircraft was substantially damaged; the pilot received minor injuries.

Ce rapport est également disponible en français.

Other Factual Information

An early morning spraying operation was being conducted by two Bell 206B helicopters from a "T" junction of two logging roads. The trucks containing herbicide and fuel were on the east/west road east of the intersection; this road ended at the intersection with the north/south road. Landing into wind would have required a hovering turn to position the helicopter for loading fuel, so the helicopters approached the landing zone from the south (downwind) and departed to the north. The helicopters were loaded with herbicide and fuelled with the engines running (hot refuelling). The occurrence helicopter had successfully completed three spray runs prior to the accident. Before departure on the fourth run, it was loaded to 340 litres of herbicide and 25 US gallons of fuel. The take-off weight would have been approximately 3200 pounds; the maximum allowable take-off weight for the helicopter was 3200 pounds.

Maximum wind speed for this spraying operation was 10 kilometres per hour (kph). Spraying operations are usually carried out in either early morning or early evening when winds are lightest. When the spraying operation commenced, about two hours before the occurrence, winds were reported to be very light to negligible out of the southwest. At the time of the occurrence, winds were estimated to be about six kph, with gusts encountered over the spray area. The herbicide truck had a piece of flagging tape attached to the antenna for the purpose of indicating wind direction.

All flight controls were examined at the occurrence site for travel and movement, and the tail rotor drive system components were examined in detail. No indication of any pre-impact anomaly in the flight control system or in the drive system was found that may have caused a loss of tail rotor authority.

On 06 July 1984, Bell Helicopter Textron Inc. issued an *Information Letter* to all model 206B owners and operators on the subject of low-speed flight characteristics which can result in unanticipated right yaw. In part, it states the following:

Recent testing of the OH-58 (military version of the Bell 206) series helicopter operated by the US Army has revealed the occurrence of an unanticipated right yaw under certain low speed mission conditions. The Army has referred to the right yaw characteristic as a loss of tail rotor effectiveness (LTE). The following is a discussion of low-speed flight characteristics which can result in an unanticipated right yaw if appropriate attention is not paid to controlling the aircraft. These characteristics are present only at airspeeds less than 30 knots and apply to all single rotor helicopters.

Unanticipated right yaw is the occurrence of an uncommanded right yaw rate which does not subside of its own accord and which, if not corrected, can result in the loss of aircraft control.

Four aircraft characteristics during low speed flight have been identified through extensive flight and wind tunnel test as contributing factors in unanticipated right yaw. For this to occur, certain relative wind velocities and azimuths (direction of relative wind) must be present. The aircraft characteristics and relative wind azimuth regions are:

1. Weathercock stability (120 to 240 degrees)
2. Tail rotor vortex ring state (210 to 330 degrees)
3. Main rotor disc vortex interference (285 to 315 degrees) and
4. Loss of translational lift (all azimuths)

If a sudden unanticipated right yaw occurs, the following recovery technique should be performed:

1. Pedal - Full left; simultaneously, cyclic - forward to increase speed;
2. As recovery is affected, adjust controls for normal forward flight; and,
3. If spin cannot be stopped and ground contact is imminent, an autorotation may be the best course of action. Maintain full left pedal until the spin stops, then adjust to maintain heading.

Information from this letter was reproduced in Bell Helicopter's magazine *Rotorbreeze*, in 1984 and 1987 issues. The United States Federal Aviation Administration (FAA) issued an Advisory Circular (AC) 90-95, entitled *Unanticipated right yaw in helicopters*, dealing with the same information. One of the conditions listed in AC 90-95, under which LTE may occur, is any manoeuvre which requires a pilot to operate in a high-power, low-airspeed environment with a left crosswind or tailwind. Other factors listed in AC 90-95 that can significantly influence the severity of the onset of LTE are gross weight and density altitude. An increase in either of these will decrease the power margin between the maximum power available and the power required to hover.



The helicopter was equipped with an agriculture navigation (Ag Nav) system. A remote switch for the Ag Nav system was mounted on a bracket attached to the left side of the cyclic stick grip. The helicopter was also equipped with a Simplex 4900 spray system; the control box for this system was mounted on the left side of the Ag Nav remote switch. The spray system control box incorporates an emergency dump switch, located on the forward side of the control box, which dumps the spray load when the dump switch is pressed in. This button is positioned to be depressed by the middle finger.

The pilot reported that he had tried to dump the spray load by depressing the emergency dump switch immediately after the loss of control occurred; however, his attempts were unsuccessful. The emergency dump switch and dump doors were tested after the accident and found to be serviceable.

The Simplex control box and the remote switch for the Ag Nav system were removed from the accident helicopter and installed on another cyclic stick in the same positions as on the accident helicopter. It was found during simulations that only persons with large hands could operate the dump switch—although this was with the ring finger, not the middle finger—and still maintain a normal grip on the cyclic. An investigator with medium sized hands (the same size as the accident pilot's hands) had difficulty pressing the dump switch. The Ag Nav remote switch was then removed from the cyclic stick which allowed the spray system control box to be mounted on the cyclic stick grip. Simulations in this configuration showed that even those with small hands could easily access the dump switch while maintaining a normal grip on the cyclic.



The pilot was certified and qualified for the flight in accordance with existing regulations, with 693 hours total time, of which 198 hours were on the Bell 206. This was his fourth season of spraying.

Analysis

When spraying operations started in the morning, winds were very light from the southwest. Because the winds were so light, it was considered safe and more practical to land from the south and take off to the north rather than land and take off into wind and have to execute a hovering turn to position the helicopter for loading.

Spraying operations are typically carried out in either no wind or light wind conditions, Pilots can become complacent about light winds, and may overlook subtle changes in wind speed or direction. At the time of the accident, winds had increased to only about six kph, with gusts. However, the helicopter was operating in a high-power, low-air-speed environment with a left, quartering tailwind, conditions conducive to unanticipated right yaw and loss of tail rotor effectiveness (LTE).

When the uncommanded right yaw occurred, the helicopter veered toward a grove of trees. The pilot had no option but to pull in collective pitch to avoid striking the trees. The increase of collective control exacerbated the situation, and the aircraft began to rotate. Had the pilot's attempt to dump the spray load been successful, it is likely that he would have been able to quickly regain control of the helicopter and avoid the tree strike.

The position of the Ag Nav remote switch, between the cyclic stick grip and the spray control box, made it difficult for the pilot to activate the dump switch because it was out of reach while his hand was on the cyclic. While he was attempting to dump the spray load, the pilot's middle finger was likely just catching the edge of the dump switch and sliding off the switch rather than fully depressing it.

Findings as to Causes and Contributing Factors

1. The helicopter took off downwind, conducive to unanticipated right yaw; the helicopter yawed to the extent that control was lost and could not be recovered before it struck a tree.
2. The Ag Nav remote switch, positioned between the cyclic stick grip and the spray control box, likely prevented the pilot from easily reaching the dump switch, adversely affecting a quick recovery of the helicopter.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 27 August 2002.