

The Super Tucano was designed from the outset for both training and ground-attack duties

# Trainers at a Cusp

The new generation of fixed-wing military trainers is finally winning sales, the more advanced categories bringing performance improvements at correspondingly escalated prices.

## Roy Braybrook

According to a recent global market analysis by Forecast International, deliveries of fixed-wing military training aircraft over the period 2009 to 2018 will average almost 150 units per year, valued at around \$ 1.6 billion. Following a peak of 212 aircraft in 2010, production is expected to reduce to 88 by 2017, due to defence cutbacks and America's Jpats (Beechcraft T-6) programme tailing off. The numbers will then pick up if the US Air Force starts replacing its Northrop T-38s.

### Piston-Engined Primaries

As of 1 February 2009 the Grob trainer series is being built by Grob Aircraft, owned by H3 Aerospace. The new company's first sale took the form of a 23-unit order for the Grob 115E by VT Aerospace. The latter already operates 97 Grob aircraft, providing elementary flying training for the British armed forces and University Air Squadrons. The Grob 115 has a 134-kW engine and a gross weight of 990 kg.

The 195-kW, 1200-kg, retractable-gear Siai-Marchetti SF-260 is now part of the Alenia Aermacchi range, under Finmeccanica. Aside from civil sales of more than 100, over 700 SF-260s have been sold to 27 air forces. Following completion of a fourth batch of 30 SF-260EAs for the Italian Air Force, production is continuing against a \$ 13.8 million order for 18 SF-260Es for the Philippine Air Force.

In the former Yugoslavia, the UTVA Lasta (Swallow) prototype flew in 1985. However, it crashed two weeks later, and the production facility was destroyed by Nato bombing in 1999. The improved Lasta 3 flew on 5 February 2009, and is being evaluated by the Serbian Air Force, which is looking to buy 15. The Lasta 3 has a 225-kW engine and a clean gross weight of 1150 kg.

For student screening, some air forces may adopt America's new Light Sport Aircraft (LSA) category. The 2004 LSA regulations apply to two-seaters with a maximum weight of 600 kg, a maximum speed of 220 km/h, a stalling speed no greater than 83 km/h, a fixed gear and one non-turbine engine. Intended to provide more affordable powered flying, this concept has generated about 100 new designs. Manufactured in low-cost regions, light sport aircraft sell for around \$ 100,000; less than half the price of a Cessna 172.

A good example in this category is the \$ 111,500 Cessna 162 Sky Catcher, which has a 75-kW engine and a gross weight of 599 kg. It is hoped to start deliveries from the Shenyang Aircraft production line in the second half of 2009. The Sky Catcher first flew on 8 March 2008.

Another lightweight US product is the Cirrus SRS (a derivative of Germany's 520-kg B&F Technik Fk-14 Polaris), which is expected to be available late in 2009.

The current LSA leaders in delivery terms are European products such as the Flight Design CT series. Flight Design's head office is in Stuttgart, Germany, and the aircraft are built in the Ukraine. The

Czech Republic has produced at least three noteworthy types: the Evetkor Sportstar, the Fantasy Air Allegro and the Czech Aircraft Works Sportcruiser. Italy's Tecnam P92 currently ranges in price from \$ 97,900 to \$ 119,900.

The US Air Force now has its initial flight screening (IFS) carried out by Doss Aviation of Pueblo, Colorado, using the 750-kg Diamond Aircraft DA20, powered by a 93-kW Teledyne Continental engine and costing around \$ 250,000. The IFS course includes 19 sorties and 25 flight hours. The programme is expected to deal with up to 1900 students annually.

### Diesels

The relatively small-scale demand for avgas has led to patchy availability, encouraging the development of diesel engines that burn turbine fuel (avtur).

Lycoming and Teledyne Continental Motors are reportedly both developing diesels, a category pioneered by Thielert Aircraft Engines, primarily with the 100-kW Centurion 2.0. Thielert, declared insolvent in April 2008, has this year reformed as Centurion Aircraft Engines, which plans to also offer the 115-kW Centurion 2.0S and the 210 to 260-kW Centurion 4.0. Diamond Aircraft, partnered with MBtech and others, has developed its own 125-kW Austro Engine AE300, likewise based on the Mercedes A-Class car unit.

### Turboprop Basics

The lower end of the turboprop range is represented by the Rolls-Royce Model 250 series, rated at 300 to 560 kW. The principal application is the Alenia Aermacchi SF-260TP, a conversion of the SF-260, using an engine flat-rated at 260 kW. The upper turboprop trainer market is



The screening of military student pilots may be performed on a sub-600 kg Light Sport Aircraft such as the Cessna 162 Sky Catcher, powered by a 75-kW engine and costing less than \$ 150,000. (Cessna)

ative with clearance for light weapons and an L-3 Wescam MX-15 day/night sensor turret with laser designator.

Rather than attempting to compete with the Washington-backed T-6, Pilatus developed a completely new trainer, the 3100-kg PC-21, with increased performance provided by an 1195-kW PT6A-68B. It first flew in 2002.

The Swiss Air Force has purchased six PC-21s to provide all-through training between the PC-7 and the Boeing F/A-18C/D (replacing the BAE Systems Hawk and Northrop F-5F). After 20 weeks on the PC-7, students have 45 weeks and 210 sorties on the PC-21. The Swiss PC-21 has a Hornet-style cockpit and Pilatus has gone to great lengths to make the PC-21 handle like a jet.

Pilatus has sold 19 PC-21s to Singapore, replacing turboprop-powered Siam-Modetti S-211s at RAAF Pearce in Western Australia. In this, the company is a subcontractor to Lockheed Martin, which is providing the training service under a 20-year contract. The deal will

dominated by the Pratt & Whitney Canada PT6 series, with ratings between 410 and 1195 kW.

The Model 250 and PT6 are basically old engines, providing scope for significant improvements. In 2007 Rolls-Royce unveiled the RR300, aimed at a nominal 225 kW, and followed in 2008 by the RR500. The latter will cover the 260 to 600 kW range, and cost less than the Model 250. Both new engines are to use a wide variety of fuels.

The Czech Republic's Walter Aircraft Engines, now a subsidiary of GE Aviation, is promoting the 600-kW M601H-80 to compete with the PT6.

Switzerland's Pilatus Aircraft pioneered the turboprop trainer category with the 2250-kg PC-7, powered by a 410-kW PT6A-25A. This led to the 2350-kg PC-9 with a 708-kW PT6A-62, which formed the basis for the 2950-kg Beechcraft T-6 Texan II, equipped with an 820-kW PT6A-68. Other changes from the PC-9 include a pressurised and enlarged cockpit, an onboard oxygen generation system (Obogs), Martin-Baker zero-zero ejection seats, a more bird-resistant canopy, single-point refuelling and an increase in wing incidence to improve the instructor's forward view. The T-6 airframe was designed for an

18,720-hour safe life, and the engine has a 4500-hr TBO.

Under the US Air Force/Navy Jpats programme, 768 T-6A/Bs will have been delivered by 2017. The total includes 283 examples of the T-6B version for the Navy, with flat screen displays and a head-up display. Export orders already account



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for 45 aircraft for Greece and 26 for Canada's NPTC. Government approval has been given for the sale of 25 to Israel, 24 T-6Bs to Morocco and 36 AT-6Bs to Iraq. The AT-6B is a counter-insurgency deriv-

supply 8500 flying hours annually (plus 3500 hours of simulator training) and includes some spare capacity to allow Singapore to offer training to other air forces. Pilatus has now sold well over 800 turboprop trainers.

Prior to the advent of the T-6, the PC-7/9's main competitor was the Embraer Tucano, of which around 650 have been built for 15 air forces (two of which are still undisclosed). Britain's RAF operates the Shorts-built Tucano with a Honeywell TPE331 engine and currently expects to retire the fleet in 2014. This could lead to the purchase of 40 to 50 new trainers, or upgrading and life-extension of the Tucano.

Featured in the title picture, the latest trainer from Embraer is the Super Tucano, with a 3850-kg clean gross weight, a stretched fuselage, a pressurised and armoured cockpit and a 1195-kW PT6-68C. It can carry stores totalling 1550 kg on five pylons, taking gross weight to 5400 kg. The Brazilian Air Force originally ordered 25 as single-seat A-29s for light attack roles and 51 as two-seat AT-29 dual-role aircraft, and has taken up an option on 23 more. In Brazilian service Super Tucanos are replacing



These Beechcraft T-6A Texan IIs are from the 85th Flying Training Squadron (Team Tigers), part of the 47th FTW, based at Laughlin AFB, Texas. The unit's 150 instructors train 450 students annually. (US Air Force)



Probably the world's highest-performing turboprop trainer, the new Pilatus PC-21 is powered by an 1195-kW P&WC PT6A-68B engine. It has already been ordered by Singapore and Switzerland. (Pilatus)

T-27/A-27 Tucanos, some of which have been offered to Mozambique. Colombia has purchased 25 Super Tucanos, Chile twelve, the Dominican Republic eight and Ecuador 24.

Korea Aerospace Industries (KAI) has developed the 2422-kg KT-1 with a 708-kW PT6A-62A engine. Some 85 KT-1s and 20 KA-1 forward air control aircraft have been delivered to the Republic of Korea Air Force. Although exports have to be approved by both Canada and the US, KAI has sold twelve unarmed KT-1Bs to Indonesia, and won the contest to supply 40 to 55 KT-1T trainers to Turkey. These will be licence-built by Turkish Aerospace Industries (TAI). The latest version is the KT-1C (also known as the XKT-1), which first flew in January 2007.

In early 2009 it was announced that Hindustan Aeronautics was discussing with the Indian Air Force the development of a turboprop replacement for its piston-engined HPT-32 trainer.

The US Air Force Chief of Staff, General Norton Schwartz, has recently indicated that the service may buy a turboprop trainer to serve in the light strike role against terrorists and insurgents. The Beechcraft AT-6B appears to be the obvious choice, but US Aircraft is nonetheless promoting its new A-67 Dragon.

Under its 'Imminent Fury' pro-

gramme, the US Navy's Irregular Warfare Office is evaluating a leased Super Tucano, presumably that purchased by the Blackwater subsidiary EP Aviation.



Alenia Aermacchi believes that, with the more powerful P&WC JT15D-5C turboprop and various refinements, its M-311 can end the turboprop monopoly of basic trainer sales. (Alenia Aermacchi)

Embraer is considering moving Super Tucano production to Florida, where its Phenom business jets are built.

### Turboprop Basics

The leading air forces now appear to agree that a high-powered turboprop is more cost-effective than a turboprop for second-phase pilot training.

Nonetheless, Alenia Aermacchi is promoting the 3200-kg (clean gross weight)

ment is completed successfully, the Indian Air Force is expected to buy 211 and the Navy 24.

### Advanced Trainers

In terms of sales, the BAE Systems Hawk has been by far the most successful advanced trainer of its generation. If the US Navy's 221 Boeing T-45A/C Goshawks are included, over 900 Hawks have been sold, and pilots of 25 nations have been trained on the type. The Hawk began with a clean gross weight of 5000 kg, but this has grown (as has that for the navalised T-45) to more than 6000 kg. Its twin-engined rivals weigh over 6500 kg.

Hawk production in the UK (28 T2/Mk 128s for the RAF, with 29-kN Rolls-Royce Adour 951s) is now winding down, although it may continue for some time with Hal in India (42 Mk 132s, following 24 built in Britain). The rejection of the Hawk by Singapore and the United Arab Emirates in 2008 marked the end of an era in which it virtually 'owned' the advanced trainer market. BAE Systems can nonetheless anticipate many years of upgrades and product support.

Early fears that the US Navy's T-45 (which is also used to train Indian Navy MiG-29K pilots) might undercut the Hawk in the marketplace have proven



As shown at its Ysterplaat AB in 2008, the South African Air Force makes no secret of the fact that its BAE Systems Hawk Mk 120 advanced trainers are also intended for the ground attack role. (Armada/RB)



The Boeing T-45A/C Goshawk, developed from the BAE Systems Hawk and powered by a 24.2-kN Rolls-Royce Adour Mk 851 turbofan, was designed from the outset to include carrier training for US Navy pilots. (Rolls-Royce)

unfounded. In the FY07 budget each Goshawk cost over \$ 34 million. In 2008 Elbit Systems was selected to provide a Virtual Mission Training System for the T-45, simulating radar and weapons use. Boeing's licensing agreement with BAE Systems expires in 2010.

The value of supersonic advanced flying training has long been doubted (due to the resulting loss in sortie duration), but there appears to be growing consensus that advanced trainers need to be more representative of modern fighters



Clearly showing its F-16 heritage, the Mach 1.4 Korea Aerospace Industries-Lockheed Martin T-50 Golden Eagle is the only supersonic advanced trainer currently in large series production. (Armada/EHB)

in terms of Sep (specific excess power) and AoA (angle of attack) clearance.

The pioneer in this field is the Yakovlev Yak-130, which first flew in 1996 and is intended later to have variable stability characteristics. Powered by two 24.5-kN Ivchenko AI-222-25 turbofans, it was selected by the Russian Air Force in 2002 to replace the Aero Vodochody L-29 and L-39. The first twelve for domestic use have been ordered from Sokol, and 16 are being built for Algeria (for pilot training and coastal patrol) by Irkut, which will also produce the next 48 for Russia. A batch for Syria is anticipated, and the Russian Air Force is expected to buy at least 200 in total. The first production aircraft had its maiden flight on 10 May 2009 from Sokol's Nozhni-Novgorod facility.

Rosoboronexport continues to promote in parallel the MiG-AT, a more conventional design. The production version will have two 16-kN Soyuz RD-1700s.

The twin-engined Hongdu L-15, which first flew in 2006, appears to be a supersonic derivative of the Yak-130, designed with Yakovlev's assistance. The production

F124-GA-200 turbofans. The M-346 (which is featured on our cover) first flew in 2004, and trials are progressing toward a design diving speed of Mach 1.20. It clearly has much higher Sep and AoA capability than the Hawk. Two batches totalling 15 M-346s are being negotiated for the Italian Air Force, and the aircraft has been chosen



Providing a major advancement in thrust/weight ratio and usable angle of attack, the Yakovlev Yak-130 is shown here in the form of the first production aircraft for the Russian Air Force, built by Sokol. It was photographed ten days after its maiden flight in May 2009. (Yakovlev)

version is expected to have an afterburning variant of the Ivchenko AI-222 and a maximum speed of Mach 1.4. Catic continues to market the much heavier (7800 kg) and faster single-engined Guizhou L-9 or FTC-2000, a derivative of the MiG-21 UTI with lateral intakes. It first flew in 2003, and the production aircraft is expected to have a 75-kN Liming WP-14C.

by the United Arab Emirates to fulfil a 48-aircraft requirement (28 trainers and 20 attack aircraft).

The supersonic 8892-kg KAI/Lockheed Martin T-50 Golden Eagle, powered by a 78.5-kN afterburning General Electric F404 turbofan, first flew in 2002. Some 82 have been ordered by the South Korean Air Force, this figure includes ten for its Black Eagles aerobatic team and 22 single-seat T/A-50 light attack aircraft.

A contract for 60 F/A-50 lightweight fighters is anticipated, keeping the production line open until 2015, and strengthening the case for this design as a Northrop T-38 replacement for the US Air Force. When the service finally replaces its 500 to 550 remaining T-38s (with an aircraft that will probably also replace early US Navy T-45s), the 'Lockheed Martin T-50' will be the clear favourite.

The T-38 first flew in 1959 and the average example is now 22 years old. High-time aircraft have reached 16,000 hours. Until recently it was planned to retire the T-38 in 2026, but the US Air Force has issued a request for information for an Advanced Pilot Training system that could achieve initial operational capability in 2017. [a]

Alenia Aermacchi took part in the early development of the Yak-130, but later broke away to redesign it into the 6700-kg M-346 Master, with two 28-kN Honeywell



Promoted as the only European new-generation advanced and lead-in fighter trainer available, the Alenia Aermacchi M-346 Master is favoured for the Advanced European Jet Pilot Training programme. The red aircraft is the first production standard model of the new breed. (Alenia Aermacchi)