

# High Precision Unmanned Agro Copters In Eco-Friendly Viticulture Systems \*

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**Abstract.** This research presents the results of studying traditional and alternative colonized systems of viticulture: organic, biodynamic, adaptive landscape. The fundamental similarities and differences in the organization of viticulture are determined. Particular attention in the study is paid to the aspects of using precision viticulture technology to increase the yield of grapes. The introduction of the Ag-rofly TF1A high precision agro drone-sprayer for all types of grape processing will make it possible to qualitatively and effectively ensure the psychopathological resistance of each grape bush to the main types of diseases that occur in the subtropical conditions of the southern regions of Russia. Providing the domestic viticulture industry with agro drones-sprayers will significantly increase the yield of grape plantations and provide the wine industry with healthy high-quality raw materials.

**Keywords:** Unmanned Aerial Platform, Unmanned Aerial Platform Control, Unmanned Agro Copter, Traditional Systems of Viticulture, Biodynamic Systems of Viticulture, Adaptive Landscape.

## 1 Introduction

Agriculture in its essence is a set of measures to obtain the required amount of food resources, based on the use of the natural conditions of the area in which the cultivation and production of food raw materials take place.

In the conditions of the XX century, the issue of the food supply of the growing population of our planet with the required amount of food with the preservation of the required quality and safety indicators began to come to the fore. The developed solution of this issue in various countries of the world is based on the available scientific data and scientific and technical means and implies both the use of the traditional system of

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agriculture – chemical and man-made, and alternative systems of agriculture and viticulture-balanced, organic, biodynamic, accurate and adaptive landscape. Studies of scientists have allowed us to establish that the use of each of the above systems to a greater or lesser extent can affect the established agrobiogeocenoses in different types of localities [1-6].

Thus, in the XXI century, scientists were tasked with developing a qualitatively new approach to agriculture and providing the agricultural and viticultural industry with new hardware and technical solutions that allow ensuring ecological balance. The southern regions of Russia largely consist of elevated landscapes and mountains, which imposes significant restrictions on the use and choice of agricultural equipment for processing agricultural plantations and vineyards

An increase in the efficiency of agriculture and viticulture in the conditions of the elevated landscape of the southern regions of Russia can be achieved by introducing unmanned aerial vehicles and ultra-low-volume spraying systems. The use of agricultural unmanned aerial vehicles will optimize numerous agricultural operations, ensure timely control of the phytosanitary condition of crops and increase the efficiency of farms [7-12]. The purpose of the article is to compare the functionality of unmanned agro copters and highlight the advantages and disadvantages of the presented models.

## 2 Main Content

The high potential for growth in the field of agricultural unmanned aerial vehicles is provided by the latest developments in the field of artificial intelligence and robotics.

Currently, the Russian market of unmanned aerial vehicles is represented by the developments of the German company "Agro Fly International GmbH "-Agrofly - TF1A, the Chinese company" DJI "-Agras MG - 1 and the Russian company"ARDN Technology " - Skyf. The analysis of the technical characteristics of the presented unmanned aerial vehicles will allow us to evaluate the effectiveness of their use in agriculture.

Technical characteristics and prospects of using the Agrofly-TF1A agro copter sprayer.

Agrofly-TF1A agro copter sprayer (Fig.1), developed by the German company "Agro Fly International GmbH", is designed for processing agricultural crops. The technology of ultra-low-volume spraying used in it allows using it to treat agricultural plantings with fungicides, herbicides, and insecticides in small quantities [8-15].

The microwave radar, which is equipped with an agro copter, allows you to effectively process slopes with a slope angle of up to 45 °. The lidar installed on the Agrofly-TF1A analyzes the altitude of the agro copter, which expands the possibilities of its use in areas with complex changing terrain, with uniform quality of processing of fields and vineyards [16-19].

The brushless motors, which are equipped with an agro copter sprayer, provide a maximum load capacity of up to 10 liters of working solution, while the most effective treatment is carried out at a height of 0.5 m to 3.0 m. The processing time of one hectare is on average from 8 to 9 minutes. The technical equipment of the agro copter-sprayer provides its ability to process rows with a width of 3.0 to 8.0 meters.

The charger, which is equipped with an agro copter, allows you to charge up to 8 6S 12000 mAh batteries within one hour, which significantly increases the amount of cultivated area of plantings.



**Fig. 1.** Agrofly-TF1A agro copter sprayer

**Table 1.** Technical specifications agro fly-tf1a

Description	Characteristics
Folded size, mm	520×520×450
In-flight size, mm	880×1200×400
Empty machine weight, kg	10,2
Maximum take-off weight, kg	22,5
Engine type	Electric Brushless Motor
Battery capacity, mAh	12000
Constant discharge current, S	15
Flight duration, min	9-11
Operating altitude, m	1,0-4,0
Maximum flight range, km	1,0

The operating parameters of the Agrofly-TF1A agro copter sprayer are:

- working time-9-11 minutes, which is equivalent to processing 1 ha of agricultural plantings;
- flight range-up to 1.0 km;
- load capacity up to 10.0 liters of working solution.

The Agrofly-TF1A agro copter is promising for processing agricultural plantings and vineyards located close to each other and occupying a small area.

Technical characteristics and prospects of using the DJI Agras MG-1 octocopter.

The Agras MG-1 octocopter is a highly specialized unmanned aerial vehicle developed by the Chinese company DJI for precision agriculture and related operations for the application of liquid pesticides, herbicides, and fertilizers.



**Fig. 2.** DJI Agras MG-1 Octocopter

A Brushless electric motor (Table. 2) provides the load capacity of the octocopter up to 10 liters of liquid solution. Processing of the area of agricultural plantings in 0,4-0,6 hectares is carried out within 10 minutes.

**Table 2.** Technical specifications DJI Agras MG-1

Description	Characteristics
Folded size, mm	780×780×482
In-flight size, mm	1471×1471×482
Empty machine weight, kg	8,8
Maximum take-off weight, kg	24,5
Engine type	Electric Brushless Motor
Battery capacity, mAh	12000
Constant discharge current, S	20
Flight duration, min	10 (with a flight weight of 22.5 kg) 24 (with a flight weight of 12.5 kg)
Operating altitude, m	1,5-3,0
Maximum range, km	1,0

The use of a combined cooling system with a centrifugal pump and a three-layer filtration system significantly increases the service life of each electric motor. The use of the DJI Agras Charger allows you to charge one battery at a time, charging a full set of batteries in the amount of 4 pieces takes – 4 hours. An intelligent control system and a

real-time microwave radio radar allow you to adjust the flight altitude with a high degree of accuracy, ensuring optimally efficient spraying of the working solution.

The operating parameters of the DJI Agras MG-1 octocopter are:

- operating time - from 10 to 24 minutes, depending on the lightweight;
- flight range-up to 1.0 km;
- load capacity up to 10.0 liters of working solution.

The DJI Agras MG-1 agro copter is promising for processing agricultural plantations and vineyards located on flat and foothill terrain close to each other and having no visible obstacles for transmitting a signal from the control panel.

Technical characteristics and prospects of using the Sky-fit unmanned air cargo platform.

The Skyf unmanned air cargo platform for vertical take-off and landing (Fig. 3) is a completely Russian development of the ARDN Technology company. Thanks to the use of various modifications of the working bodies, the air cargo platform can perform all types of work on the processing of agricultural crops.



**Fig. 3.** Sky-fit unmanned air cargo platform

Having unique technical characteristics (Table. 3) in terms of cargo capacity and flight range, the Skyf air cargo platform is capable of processing up to 50 hectares of acreage and vineyards. The use of modern control programs allows you to use a flexible spray system, due to varying spray rates for areas with different angles of inclination. The drone is equipped with radar and lidar to perform agricultural work in conditions of reduced and zero visibility.

It is established that the most effective treatment of agricultural plantings is achieved when spraying at a height of 3-5 meters, only unmanned aerial vehicles can cope with this task. Information about the consumption of processing drugs and other aspects of the work is transmitted in real-time to the SKYF chain blockchain platform.

The operating parameters of the Sky air cargo platform are:

- flight time-up to 8 hours with a flight weight of 300 kg;
- flight range-up to 350.0 km;
- load capacity up to 250 kg.

The Sky air cargo platform has no analogs in the world in terms of its technical characteristics and is a completely Russian development.

**Table 3.** Technical specifications Skyfit unmanned air cargo platform

Description	Characteristics
Overall dimensions of the platform, m	5,2×2,2
Weight of the empty device, kg	250
Maximum take-off weight, kg	650
Engine type	Electric
	Internal combustion engine
Internal combustion engine power, hp	220
Flight duration, h	8.0 (with a flight weight of 300 kg)
Operating altitude, m	3,0-3000,0
Maximum range, km	350

### 3 Conclusions

Sky-fit provides the ability to perform various multidisciplinary agricultural tasks, unlike foreign unmanned aerial vehicles, which are highly specialized. Thanks to the conceptual design of the engine and the modern control system, the drone can work not only in the mountainous conditions of the southern regions of Russia but also in conditions of variable landscapes and reduced visibility. All this allows us to recommend the Skyf unmanned air cargo platform for vertical take-off and landing, for comprehensive use in agriculture in all regions of Russia.

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