

ABAC Holland develops **Saffron All-in-One** planting and harvesting machine Report on **Prototype II**, December 2016

Introduction

The experts of the Dutch firm ABAC Holland B.V. of Julianadorp, The Netherlands, have specialised in the entire production chain of Saffron for almost 30 years. The company combines the supply of *Crocus sativus* corms¹ with its know-how on soil preparation, preparing ridges to avoid the rotting of roots, irrigation, crop management, harvest and post harvest procedures, conservation of active ingredients of Saffron as well as marketing and sales. The company constantly works on innovation and quality improvement.

Saffron has a long, documented history going back at least to the ancient Greek Minoan civilisations on the islands of Crete and Thera (Santorini) where wall paintings in the palaces of Knossos and Akrotiri show Saffron being cultivated, harvested and applied as medicine.

Saffron is the world's most expensive spice, with a retail sales price of around € 20,000 per kilogram. This price is only partly due to scarcity of the product. A glance at the pictures below tells us one of the main reasons. The harvest of Saffron flowers that takes place close to the start of the winter season, is basically executed very much in the same manner as it was done thousands of years ago.



¹ Corms is the official term for the *Crocus sativus* bulbs.

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And right here lies a major problem for Saffron growers in practically all major Saffron producing countries. The harvest of Saffron is highly labour *intensive* and is concentrated in a short period of about 10 days time. The flowers open in flushes and have to be removed early in the same day. After being plucked, they have to be brought inside where the stigma, the actual Saffron, are removed from inside the delicate flowers.

But apart from this annual apotheosis during harvest, and despite the fact that the rest of the year Saffron cultivation is quite labour *extensive*, several other stages of the entire production cycle require detailed attention and hard work by many hands.

In the first place, in order to achieve good harvests, *Crocus sativus* corms should be seen as a rotational crop. In practice this means that, ideally, Saffron should not be cultivated for more than 4 years on the same field. So at least every 4 years the corms should be removed, selected and replanted in a different location. Ideally, only after a period of at least 10 years the same plot should be used to grow Saffron, if the farmer wishes to achieve the maximum yields.

An important aspect of Saffron cultivation is the preparation of the soil. Apart from mixing the soil with some harmless but beneficial fertilisers at the beginning, it is also vital to prepare for adverse weather conditions. As the climate world-wide is changing, even traditional Saffron production areas are confronted with new realities that were never a problem.

In particular heavy rain and water clogging can cause the roots of the corms to start rotting. In order to protect the roots from water, especially on soils that do not drain (too) well (enough), it is advised to grow the crop on ridges. Preparing ridges is often done manually. This is a very labour intensive task and if this task is not done in the right manner, the effect will be far from perfect.

In a world experiencing a population growth that causes ever more pressure on the availability of arable land, it is essential to maximise on the yield per Hectare. Therefore, after the ridges are prepared, it is of equally great importance to plant the maximum number of corms per square meter. Traditionally, planting is often done manually. The use of semi-skilled and unskilled labour often causes loss of efficiency in planting. As a direct consequence the yield per square meter is also far from optimal.

After planting, which takes place mostly during the months of August and September in the Northern Hemisphere², up to the time the crop appears above the soil and is harvested weeks later, and then again after harvest through the year until the next harvest, it is crucial to have a disciplined weed control programme in place. This is where many growers are making mistakes by letting weeds become too dominant. At certain points in time, as our experience world-wide tells us, weeds can cause serious harm to the Saffron crop. Simply because weeds compete with the actual crop for nutrients. And this has a negative effect on the results, both in quality and in quantity. But then it is common to human nature to (temporarily) neglect weeds, thus negatively influencing the net results at harvest time.

Harvesting itself is not only labour intensive. It is also physically very demanding. Workers have to bend their backs for hours and for many days, causing severe back pain and gradually slowing down the pace of each worker. And those familiar with Saffron cultivation know that it is crucial during the very short harvest campaign to pluck the flowers each day at the earliest.

² In the Southern Hemisphere, in new upcoming Saffron production areas such as Australia, New Zealand, South Africa and Latin America, planting would ideally take place in the months of February and March. Much depends though on climate data, especially regarding rainfall.

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Looking for a comprehensive solution

For almost 30 years, the experts of ABAC Holland B.V. have cultivated *Crocus sativus* corms, grown Saffron and supplied their corms world-wide in countries like France, Spain, Morocco, Switzerland, Italy, Bulgaria, Ukraine, Iran, Afghanistan, USA, Japan, Australia, New Zealand, Chile and South Africa.

During all those years, the need for streamlining and a certain degree of mechanisation has become ever more evident. It is therefore that ABAC Holland, together with partners in the sector and experts in the field of designing effective agricultural equipment that is robust, easy to operate and low in maintenance, has started the development of a machine called the Saffron All-in-One (SAIO).

The starting point in developing this machine was that it should be **multi-functional**:

- to be deployed for the construction of ridges
- for planting
- removal of weeds and
- harvesting.

By the end of 2015, a first prototype of the SAIO had been completed, as can be seen right below:



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During the year 2016, a number of tests have been conducted on several locations in Europe. The tests were conducted during the various phases in the production cycle of both *Crocus sativus* corms and Saffron as a spice in the fields³:

1. uprooting / harvesting of corms in June
2. preparation of ridges before planting (July - August - September)
3. planting of corms
 - in August-September: for *Crocus sativus* **bulb** cultivation
 - in August-September: for **Saffron** cultivation
4. harvesting of flowers in October / November
5. removal of weeds during crop management cycles throughout the year.

The tests were conducted in several types of fields with several types of soil:

- sandy soil
- mixed soil
- clay
- heavy clay

and in all the above cases:

- soil with a lot of stones
- soil with few or no stones.

The issue of type of soil has turned out to be of great importance. More heavy soils will require a stronger engine with a significantly larger capacity. The SAIO in its final form will have to be designed and assembled according to specifications based on the particular characteristics of the soil of the individual client.

In 2015 - 2016, all functions of the SAIO I and SAIO II Prototypes were studied and tested in great detail.

I. Uprooting and collecting of *Crocus sativus* corms

Uprooting and collecting *Crocus sativus* corms is a relatively elementary function, less refined than some of the other functions that the final version of the SAIO should be able to perform.

Nevertheless, it is of great importance as the corms have to be secured without damage. In the case that *Crocus sativus* corm production is his main source of income, the grower has the greatest interest in maximising on the size and quality of his harvest, as this will determine his turnover and profit margins for the entire season. Safe uprooting also facilitates the next step which is the selection of corms to be sold and corms to be replanted for the next round of multiplication. Larger size corms will be sold whereas, after selection on quality, smaller size corms will be replanted for continued corm production.

³ Other activities such as corm selection and corm treatment as well as post harvest treatment are not mentioned here as they are not carried out with the help of the SAIO.

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2. Building of ridges

Climate and weather are factors in open air agriculture that cannot be controlled, altered or managed. Especially rainfall and resulting temporary flooding of fields can cause severe problems. When land with *Crocus sativus* corms is not well-drained, and water is staying above the soil for too long, for example after heavy rainfall, the immediate effect and threat will be that the roots of the corms can start rotting.

A soil sample is tested in a laboratory to determine whether any components will have to be added to the soil before planting. After preparation of the land, with compost and fertilisers as and where necessary - a task performed with a tractor and plow for example, so *not* with the SAIO - and after the land has been sufficiently watered to be in the best condition for the next step - the SAIO will be deployed to build ridges on the land. Depending on the type of soil and the actual condition of the soil, the ridges will be made 10 - 15 centimetres high.

Land that has been enriched with the right mix of compost and fertilisers will be ready for the building of ridges. Ridges will be necessary especially in soil that is **not** "well-drained", i.e. where after rainfall the water will **not** disappear within a short period of time. The SAIO will be utilised to make even ridges. Trials have shown that two ridges can be made at the same time. This double speed reduces this specific part of the preparation work with 50% of time.

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3. Planting of corms for Saffron cultivation

The planting of corms in an organised manner, i.e. with the corms planted in the most *economic* manner, is a major issue in achieving profitability. Manual planting is often - in practice - a rather imperfect operation conducted by semi-skilled or almost unskilled workers. Instructions how to plant and specific instructions with regard to the distance between corms are often not strictly followed.

This translates into an uneven division of planted material over the entire area where Saffron is cultivated or *Crocus sativus* corms are grown. This also sometimes makes the identification of (concentrations of) weeds more difficult for workers.

Land is in principle a scarce commodity. Therefore, it is crucial to maximise on yield per square meter. The Saffron yield in New Zealand and some other areas has increased to 15 kgs per Hectare (10,000 m²). With 600,000 corms planted - while evenly divided - per Hectare, and with proper soil and crop management, provided the weather conditions are favourable, such yields can be achieved during 2-3 years of the advised 4 year crop cycles. This would make Saffron cultivation a much more viable option, also in some of the traditional Saffron cultivation areas.

The **SAIO Prototype II** has been tested successfully both in The Netherlands and in Bulgaria during the planting season 2016 (August - November). Even planting has been achieved. One of the reasons for the fact that mechanical planting at a certain speed is possible, is the fact that the *Crocus sativus* corms, even when entering the soil with the roots not pointing down, irrespective of its position will eventually turn themselves in the soil with the roots establishing themselves in the correct downward facing position.

After the tests, some fine-tuning has been done to perfect the planting process even further.



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4. Harvesting of Saffron flowers

The harvesting of Saffron flowers, even though this is concentrated and restricted to a period of approximately 10-14 days per year, during the period end of October - beginning of November (end of April - beginning of May in the Southern Hemisphere), is a very labour intensive and truly tough job. The harvesters need to get up early and start plucking the flowers that have opened each single day. In traditional Saffron producing areas as well as in newly developed areas, it has become increasingly difficult to find workers who are willing and physically able to do this job. The constant bending is extremely demanding, causes backache and thus slows down the workers.

The **SAIO Prototype II** has been equipped with 2 *very different types* of harvesting technology/methods:

I. A **non-mechanised facility** for maximum 6 harvesters, who will:

- lie on a kind of stretcher
- face down
- which enables them to be in a more relaxed position
- moving forward through the field in the most disciplined manner, passing each flower for inspection
- without having
 - to bend
 - get up
 - turn to put plucked flowers into a basket
 - take steps
 - bend down again
 - while having to avoid stepping on flowers
 - and therefore often having to reach out quite far
 - while having to keep balance to avoid falling into a bed of flowers while trotting on uneven soil.

II. A **mechanised version**, that works very much on the basis of “topping” as used by flower bulb growers in The Netherlands.

I. Non-mechanised harvesting method

Harvesting is a physically demanding task. Even though the length of the harvest season is normally just about 10 - 14 days, depending on the area planted with *Crocus sativus* corms, the workers employed to harvest the Saffron will experience great physical discomfort during the harvest campaign.

The simple, non-mechanised method developed will:

- a. on the one hand increase the speed of harvesting
- b. while on the other hand the physical discomfort of the workers can be greatly reduced.

On the photograph on the next two pages, one can notice that the SAIO has been developed in a very simple manner, without over-sophistication, so that each part - if ever damaged - can be replaced or repaired very quickly. General maintenance is also very easy and therefore very affordable.

II. Mechanised harvesting method

The mechanised harvesting version is being tested and will be available shortly.

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During crop management cycles throughout the year, the removal of weeds is a continuous source of concern. Outside the harvest season that takes place around end of October/beginning of November, the Saffron cultivation is almost continuously labour extensive. This means that basically a small rump staff is kept to manage the crop.

As weed control is a tedious job, the discipline among workers is often tested and far from optimal. Therefore, weeds tend to compete for space and nutrients as well as water with the cultivated crop.

This situation is absolutely undesirable. It is essential that the *Crocus sativus* bulbs can extract all essential nutrients and components from the soil so that they can achieve the highest level of beneficial and healing substances such as Saffranal, Crocin and Picrocrocin. These substances ultimately have to enter the fragile stigma that becomes the Saffron spice.

The **SAIO Prototype II** has been equipped with a function that will remove weeds from around the area where the *Crocus sativus* corms are planted. The removal of weeds can take place all year round. This function of the **SAIO** will be very beneficial:

- for the development of the Saffron crop during the growing stages of the bulb subsoil
- for the growth of the crop during the blooming stage leading to harvest
- as well as for the development of new bulb material.

The actual effectiveness of the weed removal functions of the **SAIO Prototype II** have been tested repeatedly during trials in 2015 and 2016. It is based on various techniques, including weeding with a hoe and burning. Burning weeds requires very specific knowledge as only a slow version of this function will secure that the weeds in question will die.

Overall characteristics of the SAIO

The SAIO has been designed to become a:

- ➡ fairly low priced
- ➡ robust
- ➡ low maintenance
- ➡ easy to service
- ➡ modular
- ➡ practical tool

for Saffron growers world-wide. The SAIO is robust, yet easy to transport as can be seen on the photographs on the following pages.

Price quotations for the SAIO

Price quotations upon request after consultation with regard to specific local conditions of land, needs and requirements of the client.

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