

Arnold

Robust rootstock



syngenta®





Arnold: a fast-growing rootstock with a generative plant habit

Arnold was tested extensively in 2008 on several varieties and under varying conditions. A total of 50 hectares and numerous trial crops were planted in 2009 and continue to grow, practical proof of the strength of this rootstock. The results indicate that Arnold is excellently suited for varieties that are more vigorous by nature and for nursery growers easily able to grow more leaf volume. Arnold is also highly effective for other types of crops, such as interplantings/ summer crops.

Arnold keeps the plant exposed in early stages and therefore the plant can be managed in a generative way more quickly and easily. Arnold also periodically helps prevent the stem from becoming too heavy. It has become apparent last year that Botrytis was less likely to infect plants grafted on Arnold.

Arnold is one of several types of rootstock that Syngenta has been developing. An exciting prospect is **Arnold (500292)**, which will be tested in North West Europe in practice next year.



Round tomatoes from the very harvest!

Alain Moortgat of Broechem



Alain Moortgat

- **Location:** Broechem (Belgium)
- **Surface area:** 2.8 ha interplanting & 1.7 ha long crop
- **Main variety:** Admiro, grafted-topped onto Arnold (seed cotyledons)
- **Planting date:** interplanting on 13, 20 and 27 June
- **Start of new crop harvesting:** 4, 10 and 17 August

Cultivation schedule

In June we planted Admiro on Arnold as an interplanting. We lowered the old plants, which were planted on 3 December, under the cultivation gutter and removed them a few days later before the new plants began producing. In order to distribute the workload evenly 9,000 m² of interplanting were planted at three different times. The planting distance was 52 cm, with 2.4 heads per m², which was also the final distance. The first 4 clusters were cut at 6 fruits, followed by 5 until the end of the crop. The last 4 clusters were supported with a stem hook. We started removing head leaves on August 20th and continued to do every two weeks. This is enabled due to the sufficient

The table below shows the various results with Arnold through week 35 and the production results to date.

Variety	Plant type	Production per m ² per sub-period			
		From week 18	weeks 19-26	weeks 27-35	week 26 until the end
Admiro-Emperador	1-on-1	100%	100%	100%	
Admiro-Arnold	1-on-1	101%	102%	101%	
Zouk-Maxifort*	Grafted-topped	100%	100%	100%	100%
Zouk-Arnold	Grafted-topped	107%	99%	103%	105%
Admiro-Maxifort	Grafted-topped	100%	100%	100%	
Admiro-Arnold	Grafted-topped	104%	99%	105%	
Arvento-Maxifort	Grafted-topped	100%	100%	100%	
Arvento-Arnold	Grafted-topped	105%	104%	100%	
Growdena-Maxifort	1-on-1	100%	100%	100%	
Growdena-Arnold	1-on-1	100%	104%	101%	

* 2007-2008 season

strength of the plant. Around October 1st, we will plan to remove the heads then the last flowers on October 10th,.

Climate

In the early stages, when the new plants were still between the old ones, we exposed them to a short evening period with low temperature of 15 degrees to stimulate setting. The young plants were still in the shade at that time and cluster strength is an essential factor. Since the moment the plants grew above the old ones, we were able to maintain a good pace. From that moment on, the temperature stayed above 16 degrees at night, so there was always enough strength in the head. After two or three clusters were harvested, the temperature was raised by two degrees both night and day until a temperature of 18N/20D was reached by the end of August. The extra growth that continues at this stage is reliant upon the temperature increase. The tomatoes were still sufficiently dense, making an evening temperature unnecessary. As autumn approaches, we cultivate less intensively and increase daytime light levels. The CO₂ from the combined electricity/heat production system also allows for generative management.

What are the required qualities of a rootstock for this type of crop?

The challenge is to make sure that this type of interplanting does not become too vegetative. A rootstock with stronger effect on the fruits and less on foliage volume is particulay

appropriate. I believe Arnold meets these requirements. Arnold saves extra work in finding and keeping the right balance in the plant. With this kind of crop in particular we need a plant with a stronger effect on the fruit, contuning developing strong roots and resists picking for prolonged growth in the autumn.

What is your opinion of Arnold?

The year is not over yet, but we have already noticed that the plants have been in balance from the start. The fruits have been nice and round from the very first cluster, with only very few ribbed fruits. We also did an interplanting last year, using Maxifort. We had noticeably more problems with boot fruits and seed lumps in the initial clusters. The plants we got from the plant raiser this year were of very high quality. When it comes to interplantings, it is necessary to have flowering almost immediately after planting, which we did. The plant raiser was also very pleased with Arnold, which resulted in very uniform plants. So far, we have been nothing but satisfied!

Arnold yields more uniform plant material

Belgische PlantenKwekerij (BPK)



- **Tom Vervoort:** responsible for planning and research & development
- **Roel van Caneghem:** responsible for warm crop planning

Background of BPK

The Belgische Planten Kwekerij (BPK) is located in Duffel in the centre of the most important glasshouse cultivation area of Belgium in the Province of Antwerp. BPK is a member of the Weylandt Group, together with Holland Plant and Fortaplant. The nursery has a total of 20 ha of glasshouses, 16 ha of which are reserved for the cultivation of warm plants and 4 ha for cultivating cold plants. The company has undergone significant modernisation in recent years. In 2007, 4 ha of glasshouses were renovated, followed by 6 ha in 2008 and another 5 ha in 2009. The non-production area of the company was also fully modernised this past year.

BPK is one of the largest plant breeders for warm crops in the region. How would you describe your working method?

Our core activity is the cultivation of young vegetable plants, the most important of which are fruit vegetables that are grown for the professional market. We also grow a number of leaf crops like lettuce and cabbage varieties. Our distribution area covers Belgium, Southern Netherlands and Northern France. Another core activity of BPK is the cultivation of plants for the hobby market.

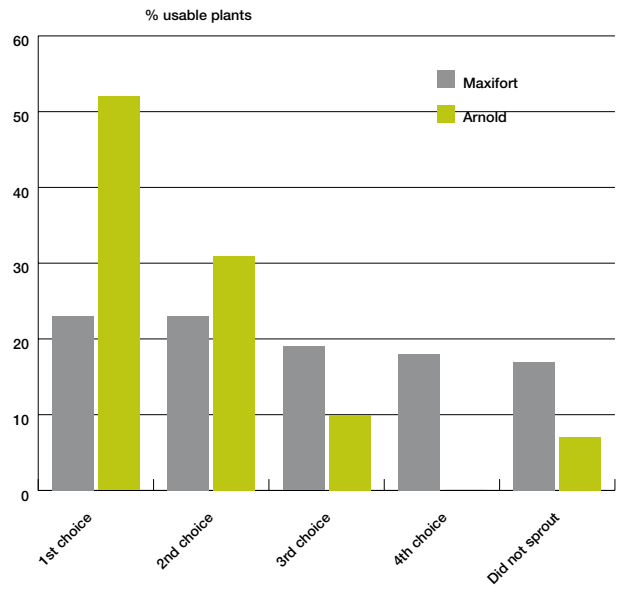
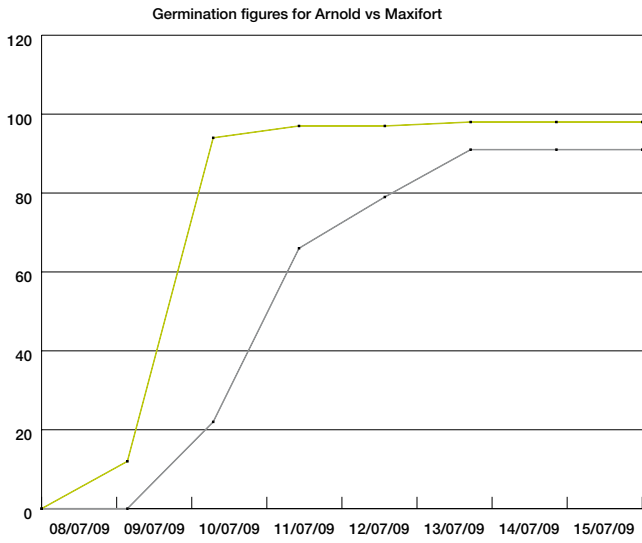
Tomato plants are our largest market product and 90% are grafted. Of these grafted plants, 75% are grafted-topped and 25% grafted 1-on-1.

More and more rootstocks are available nowadays. What matters to you most when it comes to a rootstock?

The most important requirements for us are uniformity both within a single batch and between batches. Pelleted rootstock seeds are preferable because they can be sown more quickly and result in fewer errors. Rapid development is also important because it promotes uniformity.

What is your opinion of the rootstock that Syngenta is introducing?

When sowing rootstocks, they are grouped into three different types. The quality achieved with the newest rootstocks is significantly improved. Arnold, for instance, is clearly much faster and is sown one day later than the standard rootstock. This means that it must be sown at the same time or no more than one day earlier than the cultural variety. This makes planning much easier, especially if sowing must take place on or close to the weekend.



“Arnold is fast-growing and highly uniform”

Germination figures and usable plants, Arnold versus Maxifort



Photo: Arnold (left) versus Maxifort (right)

It's more like a cultivar

Plantenkwekerij Vreugdenhil of De Lier



Background of Vreugdenhil

Plantenkwekerij Vreugdenhil is a plant raiser with more than 35 years of experience in the cultivation of both vegetable and ornamental plant products. The nursery which has a highly sophisticated machinery and equipment boasts a total greenhouse surface area of more than 18 hectares, which can be expanded by another 6 hectares during peak production periods. Continuous changing customer desires can be responded to flexibly and effectively with 75 professionals divided between two locations (both averaging 6.5 hectares) and seasonal employees during peak periods.

Grafting

Plantenkwekerij Vreugdenhil specialises in the grafting of vegetable plants. In addition to grafting for their 'own' customers, they also graft for fellow plant raisers. Investing in sophisticated equipment and knowledge allows them to specialise further in grafting.

Vreugdenhil is one of the largest plant breeders for warm crops in the region. How would you describe your working method? Growing young plants is a very important part of our overall cultivation activities. In the past the market requirements were more common, whereas, nowadays, there is more customization. Different varieties, plant types and plant sizes are delivered year round, depending on the needs of customers. We discuss all the options with customers to ensure an effective start to the cultivation process. Good cultivation combined with high-quality crops results in optimum results.

What are the latest market developments in grafting?

"Grafting onto a rootstock acts as insurance. Grafting assures growers a vigorous plant growth, enabling them to finish the cultivation process in the best manner possible especially with the challenge of emerging viruses in recent years. More than 90% of plants are grafted in the Netherlands. In other countries, in which these kinds of diseases and viruses are more prevalent, the grafting process has been developed even further."

Vreugdenhil

- **Location:** De Lier (Netherlands)
- **Surface area:** 18 ha
- **John Potters:** Cultivation specialist for vegetable plants: responsible for the entire process, from the purchasing of plant material and seeds to the cultivation strategy and after sales.

More and more rootstocks are now available. What is your opinion of this development?

Every rootstock behaves differently, so that is something we need to take into account. We consider these to be innovations and solutions that can further benefit customers. After all, rootstock innovation is in alignment with the innovative nature of the market in which we operate. We consider it a challenge and in line with our customer approach and our focus on custom solutions.

What are the most difficult challenges of grafting for you?
“We do more than 10 million grafts each year. During peak season for greenhouse vegetables we do as many as 300,000 grafts per day! You can imagine the organisational challenges this presents, regarding sowing, cultivating, reserving space, logistics, grafting, and so on. Accomplishing so much in such a short period of time requires strict planning. Naturally hygiene also plays a significant role.”

How is the grafting process organised at your nursery?

The rootstocks are usually sown somewhat earlier and sorted after around 10 days. The more uniform the rootstocks, the easier it is for the plant raiser. With less uniformity, we need to group together the different types as much as possible. After all, the slowest germinating rootstock determines when grafting is possible.”

The quality of the graft is depending upon many factors, the uniformity of the rootstock is a major contributor. The thickness and height are particularly important as it ensures the graft is not top heavy.. The plant uniformity give a better the graft quality and consequently the plant uniformity produces improved plant quality.

Machine grafting is also becoming more common. The angle, for instance, at which the rootstock and cultural variety are cut is more accurate and consistent. It is very important that plant breeders need to pay close attention to the quality of rootstock before using a grafting machine. This leads to a uniform rootstock which produces a higher yield.

What is your opinion of the rootstock that Syngenta is introducing?

Arnold germinates very quickly and is highly uniform when considering shoots, size and thickness. It's more like a cultivar! The difference between the different types is exceptionally minor, so it makes our job a lot easier. We do not have to take drastic actions to obtain enough similar rootstocks since the percentage of usable plants is very high. It also simplifies scheduling during the peak of the season. These qualities make it much easier and less expensive for plant raisers to offer quality guarantees. As far as we are concerned Arnold meets our needs perfectly. All that remains to be seen is whether the results at the end of the crop will be equally as impressive.”

Summary of qualities for plant breeders

Arnold:

Germination	>	very high
Growth rate	>	one day faster than the current standard
Uniformity	>	very high
Usable plants	>	very high



Arnold: the perfect combination with Dirk!

Herman Vlaemynck of Nevele



Patrick Olbrechts

- **Location:** Nevele (Belgium)
- **Surface area:** 3 ha
- **Main variety:** Dirk, grafted-topped onto Emperador (and a large trial on Arnold)
- **Planting date:** 8 January

Cultivation schedule

We planted the Dirk vine tomato variety on January 8th. The grafted-topped plants that were topped on the second leaf were planted at a distance of 60 cm. During week 7, we allowed 1 additional stem for every 2 stems until we reached a final distance of 40 cm. We pruned the first two clusters at 5 fruits, followed by 6. On 1st August we started pruning at 5 in order to ensure enough vigour for good final production. The

plan is to prune the final 3 clusters at 6. We expect to remove the heads during week 50 and the final flower on 10th October.

Management

As a result of our experiences with Dirk last season, when we also had problems with Botrytis, we have adjusted our cultivation strategy. Since Dirk is a significantly more vegetative variety, we are growing with much more ventilation this year. Naturally this is much easier since the combined electricity/heat production system has been operating since the start of the season. The goal is to grow a more vigorous plant by ventilating more aggressively. This includes a head wind of up to 4 m/sec. Closing the windows took place somewhat sporadically during the evenings and then only on the hottest days when the moisture level had dropped. The leaf is removed from the head weekly all year round, with the exception of the period between 1st June and 15th July.

What is your opinion of Arnold?

After seeing the good test results with Arnold combined with Dirk this past year at the Meerle Trial Centre, we decided to do an extensive weight trial. Production at the end of August was more than 1 kilo better than our standard rootstock. As a result of such positive production, we plan to take a closer look at this rootstock. We have noticed that the number of clusters per package is more uniform throughout the year. We have experienced fewer ups and downs with Arnold as far as cluster weight is concerned. In my opinion, this results in the more consistent settings. Dirk is a variety that occasionally produces some boot fruits, but, combined with Arnold, this amount is noticeably smaller. The first flower is often less dense with Arnold, which means it does not need to be removed. This makes pruning easier. It seems to us that Arnold is the perfect rootstock for a strong, vegetative variety like Dirk for obtaining the best cultivation results. We now plan to use Arnold extensively for next year's crops.

Winning combination of Arnold and Dirk

Results of Hoogstraten Trial Centre prove the strength of Arnold, especially in autumn

- **Location:** Hoogstraten Trial Centre; rootstock test
- **Main variety:** Dirk, grafted 1-on-1 on various rootstocks
- **Planting date:** 7 January

The Hoogstraten Trial Centre conducted experiments with Arnold last year. The rootstock was tested together with the Dirk vine tomato variety. The plants were planted on 7th January and grafted 1-on-1. The initial distance was 80 cm, which was immediately doubled to a final distance of 40 cm – 3.125st/m².

The results from Autumn showed that Arnold yields vigorous plants. Arnold showed an enormous final sprint due to more extensive fruit production compared to other rootstocks, this resulted in the highest Autumn production level. The combination of vegetative varieties like Dirk and Arnold appears to be a productive one. Arnold's qualities are clearly efficient under autumn conditions. fruit setting. Commonly the settings of the final cluster takes place with great difficulty, this is not problem for Arnold. A better settings results in the growth of more fruits, which is clearly apparent in the production level.

Production results (kg/m ²) per period				
	31-5	31-8	14-11	Total
Arnold	13.1	27.4	18.8	59.3
Maxifort	13.1	27.5	17.4	58
Emperador	13.5	27.6	17.4	58.5
Optifort	12.7	27.8	18.1	58.6
Stallone	12.4	28	18	58.4

% compared to standard variety per period			
	31-5	31-8	14-11
Arnold	100%	100%	108%
Maxifort	100%	100%	100%
Emperador	103%	100%	100%
Optifort	97%	101%	104%
Stallone	95%	102%	103%

Source: Tomato Study 2008, Hoogstraten Trial Centre

A complete overview of the Hoogstraten Trial Centre results can be found at www.proefcentrum.be.

More consistent growth and more uniform fruit weight

Patrick Olbrechts of Onze Lieve Vrouw Waver



Patrick Olbrechts

- **Location:** Onze Lieve Vrouw Waver (Belgium)
- **Surface area:** 2.2 ha
- **Main variety:** Admiro, grated 1-on-1 to Emperor and a large trail with Arnold
- **Planting date:** 15 and 17 December
- **Start of crop harvesting:** week 12

1-on-1 grafting

We began grafting three years ago and have focused on 1-on-1 grafting from the start. If I were to compare it to grafted-topped plants, I would say that my plant material is absolutely more uniform. Planting costs and energy input (combined electricity/heat production) are higher but you can be certain of uniform plant material. Other benefits include labor advantages in the

early stages as well as a fast growth initial and strong growth in the autumn. These advantages far outweigh the drawbacks.

Cultivation schedule

Planting takes place in mid-December at 50 cm or 2.5 heads/m². This is the head density. We decided not to keep any extra shoots for uniformity purposes. Other reasons include labor saving and higher fruit weight. We prune the first 2 clusters at 4 fruits, followed by 5. We stop pruning in mid-May and, in early August and start again at 5 fruits until the end of the crop. The clusters are then again supported starting on 1 September. Our goal is to achieve as high speed of development as possible, enabling us to attain good early production. The fast shedding of fruit makes it easier for the plant to continue growing more rapidly. The variety I grow at this planting distance and with 250kg/h CO₂ for 12 hours a day demands this kind of climate strategy to maintain high fruit quality.

What have been your experiences with Arnold?

After hearing the positive feedback from a fellow grower who carried out a successful first screening with Arnold this past season, we decided to try an extensive weight test of our own. We did a trial comparison last year of Arnold and Maxifort. Arnold had a noticeably early production start and better final production. Arnold also turned out to score better with regards to Botrytis susceptibility. We have noticed at our nursery this year that Arnold has a slightly higher 1st of May production level than the Emperor, and higher May and June production levels with consistently rising summer production. During mid-July Arnold finished its clusters better due to stronger settings, resulting in larger clusters and more uniform fruit. In mid-August Arnold also furthers the expanding production lead. I'm curious whether Arnold will even continue to expand in the autumn.

What are the advantages of Arnold for you?

I've noticed that the fruit weight remains more consistent throughout the crop. I've experienced fewer peaks and troughs with Arnold regarding the fruit weight. I believe this also explains the strong setting in July. So far, Arnold has shown more consistent growth with a more perfect plant balance, resulting in more uniform production. I am now awaiting the final crop period with confidence.

Resistants

Highly resistant (HR) plant varieties significantly limit the growth and development of specific pests and diseases under normal pest or disease pressure compared to more susceptible varieties. Highly resistant varieties, however, can still show some disease symptoms under high pest or disease pressure.

Intermediate resistant (IR) plant varieties limit the growth and development of specific pests and diseases, but can show more symptoms compared to highly resistant varieties. Intermediate resistant plant varieties show fewer serious disease symptoms or damage than more susceptible plant varieties under comparable environmental conditions and/or pest or disease pressure.

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