
SweTree Technologies

Innovators in Forest Biotechnology

arGrow®

Organic and inorganic nitrogen

Nitrogen is an essential plant nutrient, it is also the nutrient required in the greatest amount by plants. In commercial fertilizers inorganic nitrogen is the most abundant component, usually in the form of ammonium, nitrate or urea. However, several lines of evidence suggest that organic nitrogen such as amino acids may constitute potential sources of nitrogen. Based on our research, SweTree Technologies has developed a series of plant nutrition products based on the amino acid arginine. Arginine is a nitrogen rich amino acid that is easily absorbed by plants. Arginine is also a plant nitrogen storage compound, commonly used for storage under periods of elevated nitrogen supply.

The main advantages with arGrow® are:

- Simplified nutrition management
- Environmental friendly
- Optimal nitrogen status in plants
- Well developed root system and faster establishment and growth



Environmentally friendly

Nitrogen leaching which leads to eutrophication of the environment and ground water is a common problem for many forest tree nurseries. Large quantities of the added nitrogen are lost as rain wash the growth substrate. This leads to an undesired nitrogen loss into the environment and a constant need to add more fertilizer. Research has shown that arGrow® is strongly adsorbed to the peat which in turn reduces the nitrogen leakage with up till 95% during rain events, thus giving arGrow® an environmental advantage.

Three products

arGrow® Complete

arGrow® Complete is a well balanced fertilizer that includes all nutrients needed for growth. It is used throughout the season and could replace any conventional fertilizer. Due to the high binding capacity of arGrow® to the peat, arGrow® is applied weekly and does not require additional fertilization after rainfall. This leads to a simplified management at the nursery and lower nitrogen losses to the surrounding environment (Fig. 1).

arGrow® Complete Spruce

We examined the availability of different N forms and examined the soil characteristics where Picea and Abies species thrives. The result is arGrow® Complete Spruce, a well balanced arginine based fertilizer with all the advantages of arginine combined with a touch of nitrate. arGrow® Complete Spruce successfully boosts shoot

length and development at the same time as it ensures a well developed root system. The fertilizer includes all nutrients needed for growth. It is used throughout the season and could replace any conventional fertilizer.

arGrow® Support

arGrow Support only contains organic nitrogen and is used when an extra nitrogen boost is needed. We recommend treatment with arGrow® Support either when the plant nitrogen status is low by the end of cultivation. It can also be used as an extra application of nitrogen for the plant to bring out in the field in order to improve establishment and growth. Research has shown that relatively large quantities of arGrow® Support can be supplied without any negative effect.

arGrow® characteristics

Well developed root system

We have shown in several studies that arGrow® treated plants form improved root systems at the same time as the nitrogen levels can be kept at an optimal level, something that cannot be achieved with ammonium nitrate based fertilizers. Experiments have shown that arGrow® treated *Pinus Sylvestris* has double the amount of root tips and mycorrhizae compared to ammonium nitrate treated plants (Fig. 2). A well developed root system together with optimal plant nitrogen status leads to a fast establishment and growth when planted in the forest. And a higher average survivalrate can be expected.



Photo: Yvonne Hedman

A sturdy plant

The stem-base diameter of arGrow® Complete fertilized plants is also typically larger which creates a sturdier plant. This may be beneficial not only for the manual handling of the plant but also in areas with large pine weevil populations. The thicker stem increases the probability of the plant to survive a pine weevil attack. An increase

in stem-base diameter can also be expected after addition of arGrow® Support. In a recent experiment, the stem diameter increment after arGrow® Support treatment decreased the period of time when the plants were susceptible to pine weevil attack from two to one year after planting.

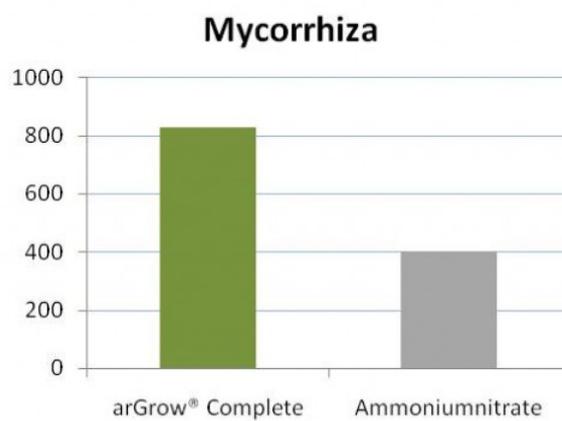
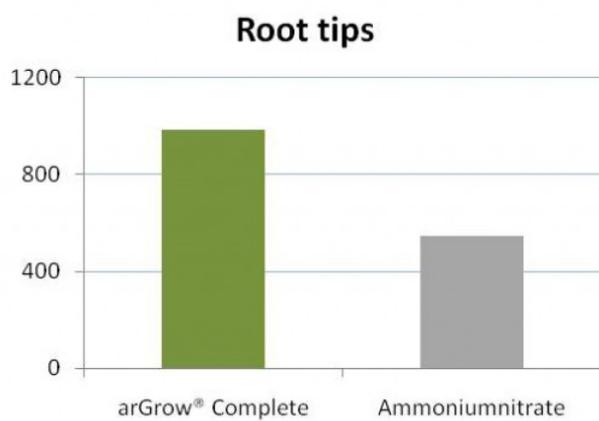
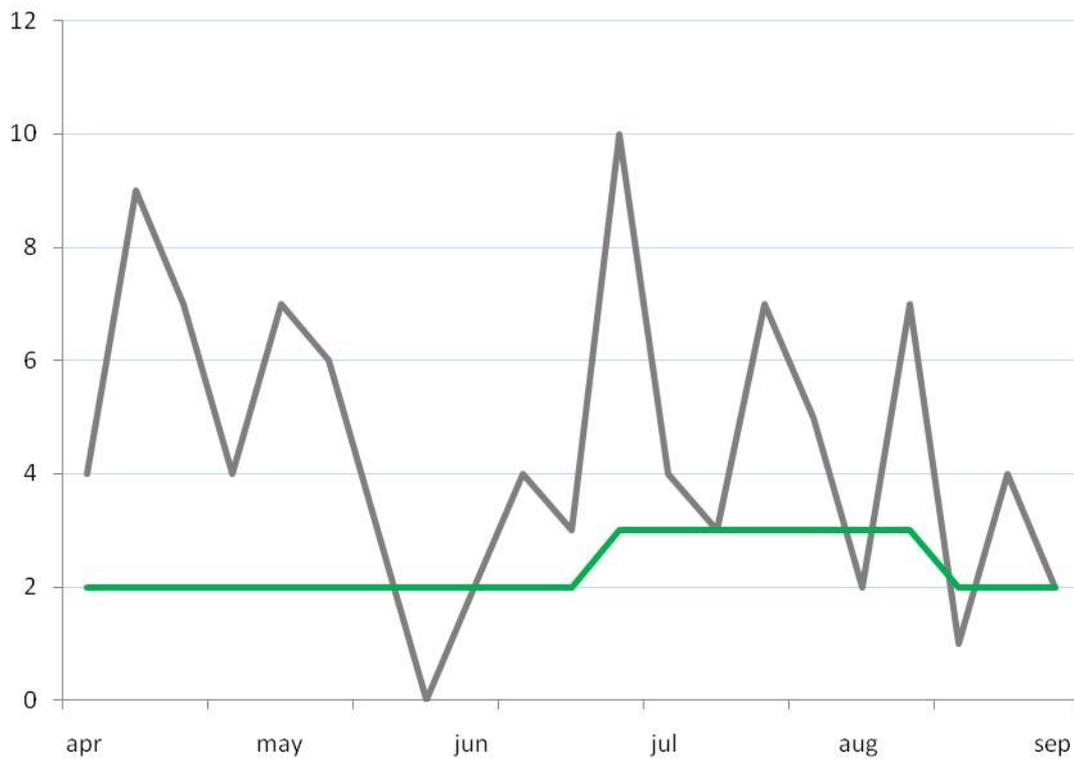
Increased growth of arGrow® plants in the field

The fast establishment of arGrow® plants is reflected in increased growth during the first years after planting in the field. In collaboration with one of Sweden's largest forest companies SweTree dug up 2400 seedlings after 3 years. The results show a significant 16 % increase in aboveground biomass for arGrow® Complete treated plants. In our longest running test, data has been collected over seven years, the results show a 40 % larger wood volume compared to plants grown on ammonium nitrate.

arGrow® today

Presently, arGrow® is being used mainly in forest nurseries and two of Sweden's largest nurseries currently utilize arGrow® for all of their production (approximately 40 million plants). arGrow® fertilizers are also used in other forest tree nurseries in Sweden, Finland, USA, Canada, Uruguay, China, New Zealand and Australia. In addition, arGrow® is being tested on other commercial crops and garden plants. General effects are increased rooting, higher dry weight percentages as well as increased depth of green color.

Are you interested in arGrow® and its potential for your plants. Send us an e-mail at info@swetree.com



Select your transgenic plants with environmentally friendly markers

Plant gene transformation is a prerequisite for the generation of transgenic trees. This process is dependent on having a selectable marker gene incorporated into the plant genome together with the gene of interest. Until now, these marker genes have mainly been antibiotic resistance genes. Due to a growing concern from regulatory agencies about the use of antibiotic resistance for this purpose, there is now a strong demand for alternative, environmentally friendly markers.



- Our D-amino acid technology can function as a universal solution for a variety of applications and has the potential to make a significant impact on transgenic forestry in general.

Selection markers

We have patented a novel method using D-amino acids as a selectable agent to identify and select successfully transformed plants. Plants lack the capacity to metabolize D-amino acids, several of which are toxic to plants. By inserting a gene involved in D-amino acid metabolism into the plant, together with the gene of interest, the former serves as a selectable marker for successfully transformed plants.

The phenotype of a plant transformed with D-amino acids metabolizing enzyme is clearly distinguishable from the wild type immediately following germination when treated with D-amino acids. Selection as well as counter selection is possible using D-amino acid oxidase (DAAO) as selectable marker and different D-amino acids as selectable agents.

Herbicide resistance

Some of the novel marker genes based on D-amino acids also function as herbicide resistance genes. This will be extremely useful for plantation forestry where intense herbicide treatment is often required. The D-amino acids used will also serve as a source of nitrogen for the transgenic plants.

Transgenic containment

Using certain D-amino acid derivatives for counter selection, the DAAO marker can work as a herbicide that selectively kills transgenic plants containing the DAAO marker and leaves all wild type plants alive.

