



A Biology Group Work of Steffen Biniash and Fabian Rauschenbach

Class 4a

Hybrid Seeds – An Excerpt from Modern Agriculture

1. Preface

We made our first experiences with hybrid seeds while watching the movie “We feed the world”. The advantages for mankind and the problems they can cause to nature were only a small part of a discussion about nutrition of humanity in the future. I was concerned about the changes which happen in big food companies and had to think about it for a long time. When we then got the order to write this portfolio, I was sure that I want to work on this topic. After having a short talk with Fabian, who’s doing this project with me, we soon came to the conclusion that we both are interested in hybrid seeds and willing to spend several days on working on them.

The probably most interesting chapter on hybrid seeds deals with their production. Furthermore it is important to be informed about ethical aspects of the production of genetically changed products.

Questions

1. Where are advantages/disadvantages of hybrid seeds?
2. Is the big controversy about hybrid seeds justified?
3. Why are farmers interested in the use of hybrid seeds?
4. Can hybrid seeds solve the worldwide hunger problems?



Picture 1

2. Introduction

What is the context of the chosen topic?

Fruits and vegetables from hybrid seeds are the first step to the economically seen perfect product. They are attractive to customers because they look better than natural products, are faster growing, resistant against diseases and insects and therefore reason for the possibility to increase the harvest. As an example the combination of a wild with a good looking tomato leads to a robust and attractive fruit. Unfortunately hybrid seeds aren't reusable products and therefore make farmers dependent. Because the production needs a high number of workers it is an efficient method to reduce unemployment.

The Scientific History

Main development took place in the United States of America and started around 1920. Henry A. Wallace studied agriculture at the Iowa State University and became later Vice President of the United States. He was the first person who had profitable ideas and concepts for developing hybrid maize seeds. By founding the first hybrid seeds producing company he revolutionized agriculture. The first corn hybrids were produced by removing the male flowers of a plant. That's why female flowers could not have been pollinated by male flowers from the same plant. In 1970 hybrid rice pushed hybrid production because to a big request on the Asian -mainly Chinese- market.

Places where Hybrid Seeds Are Used

Whereas the deployment of hybrid seeds in Middle European countries is decreasing developing countries increase the exert of those products. Hybrid seeds are the best possibility to produce huge amounts of plants and make the most money. The advantage of these seeds guarantees the farmers a big and good looking yield. Produced by big companies like Monsanto or Bayer the hybrid seeds are sold in all countries of the whole world. Alternative treatments are only the usage of non-hybrid seeds.



Picture 2

3. Description of engineering technique

Explanation of the applied technique

Growing Conditions

In order to produce high quality seeds it is inevitable to have perfect growing conditions. At the example of tomatoes there must be a humidity rate under 60% (to reduce the risk of diseases) and temperatures between 21 and 25°C at daytime and 15-20°C at night. Furthermore the constitution of the precursors planted on the fields is important. They may reduce or increase the risk for diseases and insects. Paddy rice reduces for example the probability for tomatoes to become afflicted by nematodes and insects. Disorders as blossom end rot are common disorders are common when the pH of the soil is to low.

Choice of Parents and Sowing

In order to achieve the best result the choice of parents is very important. Hybrid seed production consists of the crossing of two inbred lines in which it is of no importance which line is selected as the male, which as the female parent. Usually the female parent is taken from the best seed yielder.

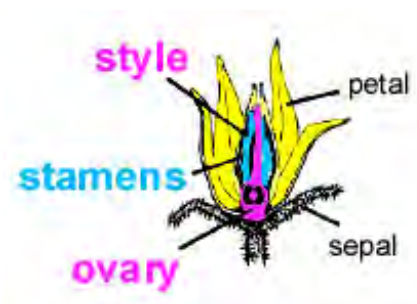
Parents are selected for their desirable traits (high yields, disease resistance, fruit quality, earliness, etc.). In favour they should be pure and self-pollinated for more than 6 generations. This process is called inbreeding. To practice hybrid seed production pollen have to be available in a big amount to ensure the fabrication of hybrid crosses. Male tomatoes bloom profusely, thus a ratio of 1 male for 4 female plants is sufficient. To assure that pollen is available male plants are sown 3 weeks before the beginning of the breeding operation.

Isolation

Apparent from the picture each tomato flower consists of male and female parts. Style and ovary form the Pistil, the female organ, whereas the stamens the male organ is. Because many of today's tomato lines are self-pollinating it is not necessary to isolate their flowers from each other by using nets or cages to avoid insects. Otherwise pollen from other plant where the male organ is not removed could pollinate the female flower.



Picture 3



Picture 4

Cultural Practices

In order to get best pollen for hybrid seed production, several rules have to be applied. Beside the water and nutrition management the plant location (distances between the beds and plants, sun influence) and the characters (shape, size, and colour) of the fruits influence the result and therefore have to be regularly controlled and advanced. Furthermore infected fruits should be removed before hybridization process is started

3.1 Production of hybrid seeds

The aim of hybrid seed production is to cross two different lines to combine their good characters. Thus self-pollination isn't allowed and has to be disabled. This can be done by removing the male stamens from the flower before they bloom and shed their pollen. It can be accomplished 55-65 days after the sowing and is called **emasculation**.

With sharp forceps the flower buds have to be opened. Then the anther cone- which includes the male organ- has to be removed leaving pistil, corolla and calyx. To identify the prepared flowers from usual flowers they have to be marked, e.g. by cutting some leaves.

From the male parents pollen has to be collected. Whereas pollen collection should be avoided after rainy days it is advisable to collect pollen in the early morning. The anther cone (see clause before) has to be removed after drying it for 24 hours. They can be kept for one day at room temperature; in general the fresher they are the better for high quality seeds.

Usually emasculated female flowers are pollinated two days after emasculation when the corolla of the flower turns into a bright yellow, which is signalling that the stigma is ready for pollination. For pollination it is recommendable to expose the stigma and put the latter into the bowl with the pollen or pollinate it with your finger. The number of produced hybrid fruits depends on the size of the parental fruits. Hybrid seeds can be easily recognized by their cut sepals. With the help of this character naturally-pollinated fruits have to be removed, which will actually prevent a mixture of hybrid with non-hybrid fruits and assure enough nutrition for the growing hybrid fruits.

Harvesting the fruits should take place 50-60 days after pollination when they are in the pink or red stage. To prevent reactions affecting seed viability the fruits shouldn't be collected in metallic boxes. After harvesting the fruits have to be extracted from the fruits. The fruits have to be crushed preferably in a readily container to wash unwanted fruit parts away after 1-2 days of fermentation. The washing should be repeated several times until the clean seeds are leaving at the bottom. Afterwards the seeds have to be dried, taking about 3 to 5 days until the seeds have the desired moisture content of about 6-8%. After having completed these steps carefully the hybrid seeds are storable up to 5 years.

5 Discussion

What progress was made with the application of the chosen technique?

With the invention of hybrid seeds agriculture changed significantly. The fruit can be manipulated until you reach the perfect look and shape you like to have. The fruits grow much faster than the normal and need less care. The clients and consumers can be blinded with sterile perfect fruits and will buy the better looking product instead of going for the best tasting product. Furthermore the transport is better bearable for the fruit.

What future research steps.

In the future the researchers will try to find a way to make the fruits better tasting. It would also be possible to make the seeds fertile, but this won't happen because the companies earn a lot of money with selling every year new seeds. Also the positive abilities could be optimized and therefore the researchers could try to let the seeds have bigger yields than they have at the moment. The fruits could in the future protect themselves against insects or diseases, without poisons. Maybe the nutrients like proteins, vitamins or something like that will be increased to fight against hunger and feed the world.

Discussion of ethical aspects.

Pro	Contra
<ul style="list-style-type: none">- bigger yields- good looking fruits- faster growing of the fruit- can resist against some diseases	<ul style="list-style-type: none">- loss of taste- disposable product- not very self-adaptive- expensive

Dangers of the hybrid seeds are that with the reduction of the genetic diversity, the ecological system is vulnerable to collapse.



Picture 5



Picture 6

6. Summary

The Production of hybrid seeds started around 1920. The American scientist Henry A. Wallace recognized the capabilities of hybrid seeds. In 1970 the Asian market developed a big request for hybrid rice and pushed their production. Hybrid seed production is a time- and labor-intensive work, very complex but not difficult. Production can be done without the use of expensive and complicated machines and offers the scientists and the farmers a bunch of crossing possibilities. In order to produce high quality seeds it is inevitable to have perfect growing conditions. Parents are selected for their desirable traits to achieve best results. In favour they should be pure and self-pollinated for more than 6 generations, a process which is called inbreeding. After pollen and the anther cone are separated the pollen has to be dried. Pollination of the female flowers can be done mechanically or by hand. Important is only to make sure there is no self-pollination because then self-pollination wouldn't be possible. Removing the male stamens from the flower before they bloom and shed their pollen and very important to prepare hybrid production, which aim it is to cross two inbred lines. Harvesting the fruits should take place 50-60 days after pollination when they are in the pink or red stage. The fruits should be collected in a non metallic container to avoid acidic reactions which downgrade the fruit quality. The resulting fruits are created by the wishes of humans. There's a big controversy ongoing about ethical aspects. Is it okay to influence nature in order to satisfy our wishes? Is a good looking fruit legitimated by accepting a worse taste? Actually companies like to say hybrid products could solve feeding problems. According to statistics of WHO there would be enough food for twice as much human then now. This leads to the conclusion that the distribution is not good enough and therefore hybrid seeds not the solution. Every single person has to decide on her own whether she wants to buy and eat hybrid seeds. There are no dramatic dangers, its more like an moral problem.



Picture 7

7. References

Pictures

- Picture 1:** http://www.lebensmittelfotos.com/wp-content/gallery/gemuese_hg/tomaten_001_missfits.jpg
- Picture 2:** <http://www.heinz.com/CSR2007/seeds/head.jpg>
- Picture 3:** http://farm1.static.flickr.com/194/517560339_bdc986175d.jpg
- Picture 4:** <http://www.avrdc.org/LC/tomato/hybrid/06flower.jpg>
- Picture 5:** http://www.brtagandturf.com/images/photo//0383_207_240.jpg
- Picture 6:** <http://mdvegetables.umd.edu/images/-Tomato%20field%20late%20in%20the%20day.jpg>
- Picture 7:** http://www.bonappetit.com/images/tips_tools_ingredients/slideshow/2009/06/-ttss_25_tomatoes_intro_h.jpg
- Picture 8:** http://www2.dupont.com/Media_Center/en_US/assets/images/releases/-nr_Pioneer081109_Utica_IL_0009.jpg

(Title Picture made by Fabian Rauschenbach Designs)

Information Sources

<http://www.avrdc.org/LC/tomato/hybrid/03intro.html>

<http://www.i-sis.org.uk/hybridSeed.php>

<http://myediblelandscape.wordpress.com/2009/03/08/heirloom-vs-hybrid-vegetables/>

And the film “We Feed The World”



Picture 8