

PROJECTS MDM AND PADGG

DEMONSTRATION & TRANSFER OF INFORMATION
ON LONG LASTING AGRICULTURE

SUMMARY PATATOES 2005-2006

Execution:

Foundation



Agrikos

**Two regular and
six biological growers**



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EFFECTS CULTIVATION TIME SPAN POTATOES

Between 1986 en 1996, experiments were done regarding the influence of tillage time on growth and health of crops. These experiments showed, that the annually existing cultivation problems like *Phytophthora* in potatoes relate to tillage times. The projects PADGG and MDM demonstrate this method at six biological and two normal enterprises between 2005 and 2008. Adequate tillage times are recommended, in order to reduce *Phytophthora Infestans* and other cultivation problems by 90% and also to improve quality and yield of the potatoes. In order to get a statistical report, multiple tests will be added in next two years.
Hans Bruinsma

Tillage time as cause of Rhizoctonia

During 2005, the race Frieslander showed that the recommended tillage time to reduce *Phytophthora* is also good to prevent *Rhizoctonia*. The newly recommended tillage time resulted in *Rhizoctonia*-free crops in contrast to a total infestation in the other group. Also, the recommended tillage time resulted in a 70% higher gains, refer to image 1. In 2003, the Gloria species (picture 2) showed a comparable difference. It is believed that *Rhizoctonia* arises from planting on cold ground. In these circumstances, there was hardly a difference in planting time although the affected group was planted a little later. Also, they were planted in directly opposite fields.



Adjusted tillage time: 70% higher yield and *Rhizoctonia* free.



Monotonous tillage time: total *Rhizoctonia* infection.



Picture 2: Result of 2 cultivation methods for the Gloria species in 2003, resulting in a 100% difference in *Rhizoctonia* and a large difference in selection and harvest.



Picture 1. Frieslander species, big differences in quality, health and yield.

Advised method for aimed tillage times potatoes

The suggested tillage times are determined by the Sun and Moon-positions in the signs of the zodiac, principally named Earth, Water, Air and Fire. Totally, this results in sixteen tillage times, which occur in the entire year. Three of these tillage times are used for potatoes. The first one is used for the croplevel (level 1) and enhances the tuber-placement. The second one is for the specific product-quality (level 2) and enhances the number of tubers and fine quality, which distinguishes the potatoes from most other types of tubers. The third cultivation time enhances the variety (level 3), which means, the specific type of tuber, for example a long and round or oval type of tuber. The last one differs per type and requires additional research per type. Through the application and variety of these cultivation times, a good well balanced growth arises, which shows mainly in quality, health and yield of the tubers. The cultivation time of the productlevel (level 2) is hardly used in the North West of Europe. Experience from 8 years of research has shown that by using the product level (level 2) tillage time, the best results in quality, growth and health of the crop could be achieved. Besides, it is taken into account with the effects of cultivation in prior years on the crop through the seed material and with the former cultivation at the grounds to be cultivated.

Clear differences in appearance and results of tubers of early species

Just like in the previous investigation, the early varieties showed clear differences in cultivation and results in the first year, when different tillage times were used. This was the case in all early races involved: Junior, Frieslander and Raja. By using tillage times, length, width, smoothness and yield of these species could be enhanced. The later species hardly showed any differences in tuber appearance and yield, when using different tillage times. This was also the case in earlier investigations. In the coming year, the idea is, to breed with some groups of later races. It is expected that clear differences in appearance and yield will exist, like in the earlier tests.

Picture 3. Different tillage times of Junior species resulting in three types of growth



Stronger growth in length.

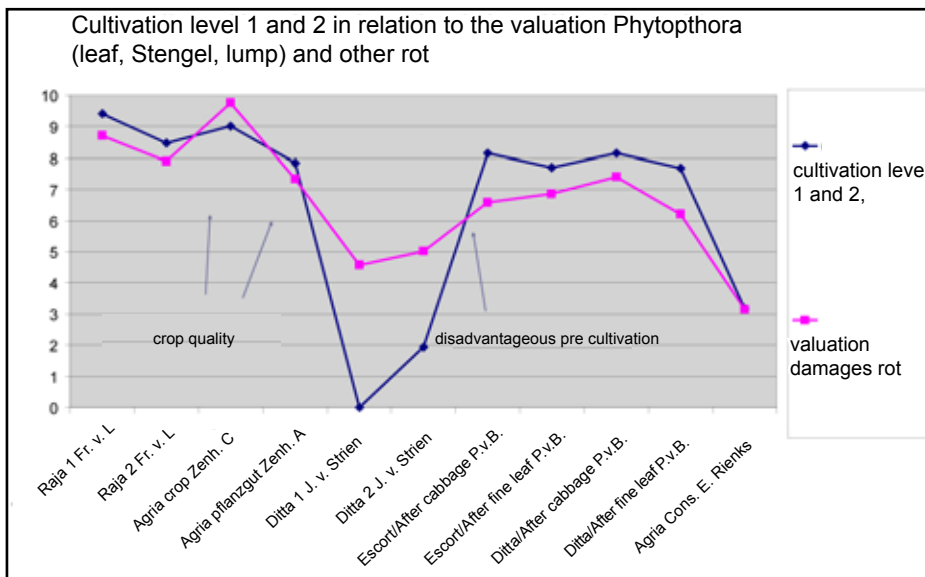


Weak growth.



Stronger growth in length a width and highest yield.

Graph 1

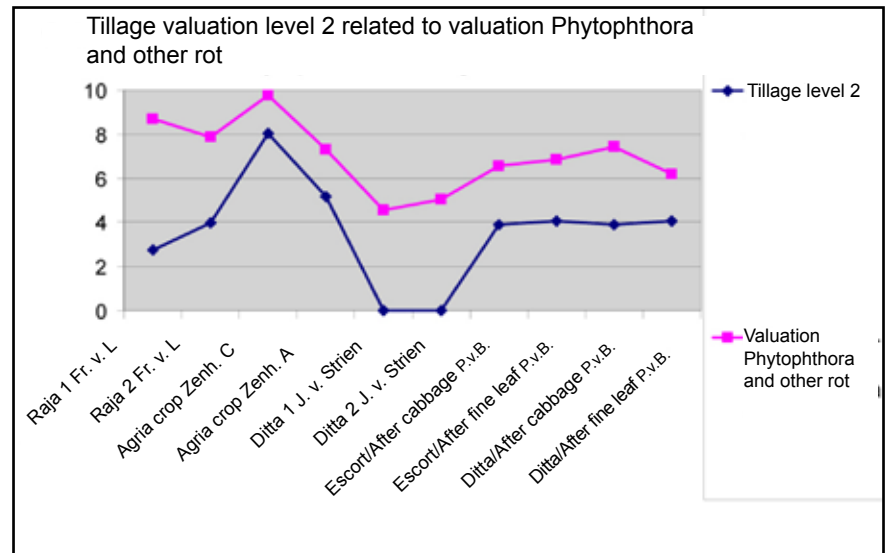


Results damage caused by rot related to tillage of level 1 and 2

Graph 1 shows (blue line), in a 0 to 10 scale, the realized tillage times in a group of crops (level 1) and the individual productlevel (level 2) added together. This involves eleven cultivations of late varieties of potatoes at five companies. Secondly, a valuation is shown (red line) for the cultivations with regard to the affections by rot. This is the joint valuation for Phytophthora (leave, stalk and tube affection together), blackleg, bacterial soft rot, sclerotonia and dry rot. Graph 1 shows that the tillage times for level 1 and 2 strongly correlate to this valuation. The lowest valuations for the damage caused by rot (Ditta 1 and 2 J.v. Strien) differ the most. However, it

is common, that these figures are lower at the recalculation in the winter and strengthen in spring, which makes them closer to the line of cultivation. The highest valuation for damage caused by rot (third one to the left, species Agria from Jan Zielhorst) is higher than the tillage score. This object was without infection of rot, except for a slight Sclerotinia damage and very little Leave Phytophthora without damage to rot. Also, no damage was present, unlike the other groups. Tillage time to the productlevel is used most strongly in this group (approx. 80%). The lowest valuation in graph 1 coincide mostly with tillages between April 19 and May 15. Also from prior research this period proved to be most sensitive to Phytophthora and other rot and is therefore discouraged, except for some species. Rienks and Van Strien used this period in 2006 and obtained the worst results of all growers. Commonly, this period is used very often, especially for later varieties. When lookingt separately to the Phytophthora

infection of leaves, the 80% application for the product level for Agria at Jan Zenhorst got a valuation of 9.75. During the second Agria cultivation of Zenhorst, the tillage for productlevel was used for more than 50% and the valuation of leave-measure Phytophthora decreased to 6,9. The other growers reached no more than 40% with this cultivation-time and obtained an average valuation of 7. During earlier research, it became clear that application of 40% in the productlevel was sufficient for a healthy crop, if this application was also done in prior years. However, after failing to appear for several years, which is usual in de Dutch situation, only 100% application can repulse the Phytophthora-mold fully, most frequently, after a two year application. The best application by Jan Zenhorst with a level of about 80% approaches that situation and the result is accordingly. It has to be taken into consideration that we are talking about the quality of seed tubers. With older material and more years of adverse cultivation-effects in the tubers, the result could possibly be even worse. The experience is that in order to improve results, a second year with a comparable high application is necessary.



Graph 2. Tillage for level 2 (product level) only, already strongly correlates with damage due to Phytophthora and other rot. In the switch phase, level 2 gives the most improvement on average.

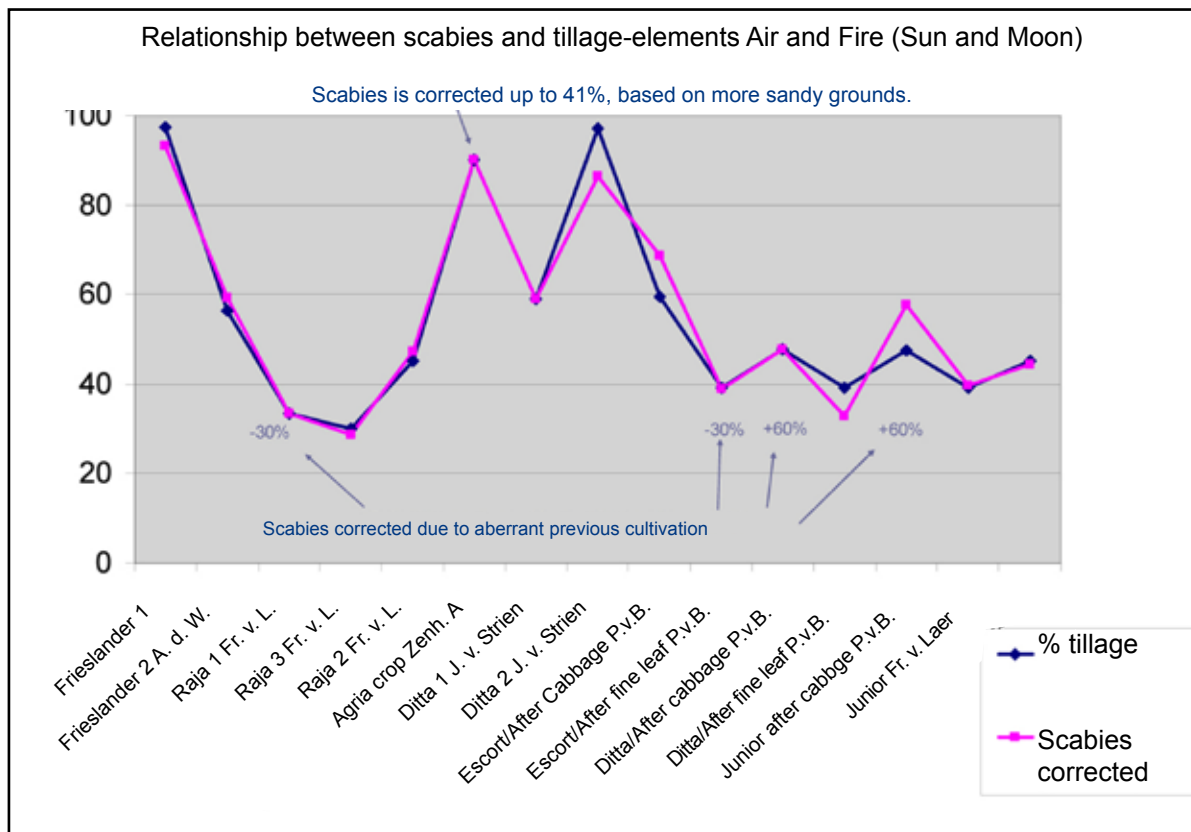
Tillage-time causes scabies

As was already noticed in 2005, scabies became higher, in association with tillage times of which was clear from prior research, that they result in a drier growth of tubers and higher number of tubers. This is mainly the tillage-period from April 19 to May 15, which is not recommended for most potato-species, but also the tillage time for the productlevel. This causes, that these tillage time on sandy soils should be applied moderately and in a controlled fashion. Graph 3 shows tillage time as a percentage and related to the percentage of scabies attack. Three corrections are absorbed in the scabies-sensitiveness:

- Firstly, the difference in scabies-sensitiveness per race is equalized.
- Secondly, the influence from the breeding of the previous year is equalised. This was necessary four times. Influence of the last growth is established in the prior research and is tested again in 2006 for the varieties Escort and Ditta at Pieter van Bentum with two different pre-growths. These new measurements showed, that differences in the prior growth can decline rabies to 30% or can increase it up to 60%. A prior growth can disturb, when it has similar elementary qualities as the current cultivation-times. Such a disturbance can, as was noted earlier, have an increasing or a diminishing effect on both attacks and yield and quality. Besides three corrections, related to this, during the research at Pieter van Bentum, there was a correction necessary at the species Raja at Frans van Laer resulting from the difference in the grazing of the former meadow.
- Thirdly, an adjustment is made on an Agria cultivation from Jan Zenhorst, because it was located on more sandy and scabies-sensitive ground. Calculations show, that this extra sandy soil increased the scabies affection by 41%.

After corrections on various species, pre-growth and terrain-type, the tillage times and rabies-affection coincide almost exactly. Only the Ditta-species at Joost van Strien en Pieter van Bentum shows slight differences. The reason for this difference may lie in the fact, that the grounds at Joost van Strien are more heavy, which causes a less strong effect, be it negative or positive. Also, there can be a difference in the origin of the seedlings. However, the tendency for both Ditta breedings is consistent with the overall view.

Graph 3



Rhizoctonia and necessary and appropriate times for tillage

Damage by scabies seems to increase when using tillage-times, that lead to a drier way of growth. On the other hand, Rhizoctonia seems to increase when using tillage times leading to wet ways of growing, Table 1 demonstrates this contradiction based upon measurements in 2006.. Only at Agria, there is a deviation from this tendency that can only be explained by a difference in soil.

One can conclude that balancing the usage of these tillage-times is the way, to fight both rabies and Rhizoctonia. As mentioned earlier, infection by rot decreases by using the tillage-methods for both level 1 and 2 and probably also for level 3. Application of 33% for each level is therefore the advised starting-point and based on the earlier research experience, this should be achieved within 3 years. The skipping of 1 and 2 levels may be done for 1 or 2 years, but has to be corrected later. If tillage time for level 3 is unknown, 50% for level 1 and level 2 is recommended.

Table 1

Growth	Damage	
	Rhizoctonia	Schurft
Frieslander 1	0	126
Frieslander 2	100	80
Raja 1 +2	1,5	70
Raja 3	7	42
Agria on lighter grounds	25	70
Agria	26	27
Ditta 1	26	97
Ditta 2	36	77
Escort after tuber	0	64
Escort after fine leaf	11	35

Table 2. Summary of pathological problems as well as their solution through tillage-times

Problem	Solution
Scabies	Tillage time, resulting in a less dry growing type = level 2
Rhizoctonia	Tillage time resulting in a less watery growing type = level 1
Forms of rot, a.o. Phytophthora	Balance of Tillage-times on level 1, 2 en probably also on level 3
Total	In 3 years, balance in tillage-times for all 3 levels

Research variety-level of potato race Raja

The variety Raja reacted very well to the balance between tillage towards crop level and product level at breeder Frans van Laer in 2005. This expressed itself in nice shiny tubers with a high level of health and yield. He repeated this in 2006 and achieved the same results. Besides this, in 2006, two additional tillage-times were used, in order to test the variety level. The research-experience with the variety-level is, that a false tillage-time does not show in the way of growth and also, that an appropriate tillage-time reflects strongly in the way of growth. This fact is also the case for level one and two. Raja can be described as a smooth, round, long-oval tuber, without much irregularities. Therefore, in 2006, extra sun-action was used at one field for the rounder shaped tubers and at another field for the longer shaped tubers. The first application indeed resulted in wider tubers. Beforehand, it was expected, that this sun-action could be appropriate, because Raja normally grows better than most other species when applying tillage in this period. The second additional tillage, in order to add more length to the tubers, did not work. No longer or otherwise different tuber-growth could be perceived. Therefore, it can be concluded with some reserve, that the length-feature of Raja bears no direct relation to the sun-action in question. Therefore, starting in 2007, the corresponding moon-action will be used to research the length-action. The sun-action will continue to be used in order to get extra width. This sun-action is easy to use in the Dutch spring. Therefore Raja proves to be an appropriate species for breeding in Holland. With the aimed application towards the variety level it is expected, that a more watery tuber will result, this leading to lesser sensibility to black spot bruise, shatter bruise and skinning.

More length and higher yield by application of the variant level for Junior

Determination of the appropriate tillage time for the variant level of the species Junior is also progressing. In 2005, on the farm of Pieter van Bentum, a tillage time applied towards the sun action that was known to improve length growth showed to be profitable for this race. On the farm of Frans van Laer this additional tillage was not applied for the species Junior in 2005 which resulted in much shorter tubers with less weight. Following these findings Frans van Laer also applied this tillage for Junior in 2006 and the result was much more length in the tubers and a much better development of tuber size and yield. Pieter van Bentum on the other hand did not apply this tillage in 2006 and the length and yield decreased accordingly. On the basis of these findings, this tillage towards the variant level is advised for the species Junior. It is not yet known which tillage time on the variant level according to the Moon action should be advised.

Appropriate variant Red Baron results in high yield

Red Baron is a variety with a tuber type that on the variant level seems to fit in with the tillage time between April 19th and May 15th that is commonly used in the Netherlands. This period is favourable for a small, rounded tuber type with a high number of tubers per plant. Species of this type are expected to grow well and healthily when this tillage time is applied. Table 3 shows the actually applied tillage times over 2006 and the aimed tillage times for the race Red Baron. The table shows a balanced and reasonably high score of 72%. This may have contributed largely to the high yield per area (72 tonnes per hectare = 642 cwt/acre) that was attained. The most important deviations from the ideal situation are a lack of 14% Sun-Air and 33% Moon-Water and a surplus of 15% Sun-Fire and 24% Moon-Fire. Most striking was the over presence of the Moon element, 39% in total, which was indicated by a high presence of double tubers in the harvest. It is advisable to aim for a replacement of Fire action by a more suitable Sun-Air and Moon-Water action. On the farms in question of Herman and Jaap Vermeer this should be feasible. By applying this tillage a more optimal harvest is to be expected.

Table 3.

Red Baron	Sun		Moon	
	Aimed	Actual	Aimed	Actual
1. CROPLEVEL	33% Water	34% Water	33% Earth	25% Earth
2. PRODUCTLEVEL	33% Air	19% Air	33% Fire	57% Fire
3. VARIANTLEVEL	33% Fire	48% Fire	33% Water	0% Water

SUMMARY AND CONCLUSION

In 2005 and 2006, comparison of tillage times were done on directly adjacent small fields, on bigger adjacent field and on various farms. The early races demonstrated expected differences in appearance, yield and tuber infection. The later species showed matching results for crop health, but not for tuber appearance and yield. This is in accordance with results from earlier experiments. In a follow up year, it is expected that those differences will become apparent, provided that the same working method is applied using the same breeding material. In 2005 and 2006 the best results were clearly achieved with the best optimization of tillage times. Various breeds that were performed traditionally showed the worst results. Applications that met with optimal tillage advises only partially, gave intermediate results.

In order to attain better results in 2007, project participants will have to apply the advised tillage times to a higher degree. This requires quite some adaptations from the enterprises. A well balanced application of tillage times of 33% for any of the 3 levels is aimed for and if the appropriate tillage for the variant level is not known, a 50% application for levels 1 and 2 is advised. At the same time, for professional growers it is advised to apply the method over a range of years and record the results, including the final harvest.

To realize repeatable large differences in tillage times - so as to yield statistically justifiable results - it is necessary to include a multiple test. In this way differences in growth and infections can be forced without harming commercial production. This is a condition demanded by the sector.

The scope of experimenting with additional tillage times for various races has to expanded in cooperation with breeders. Without the inclusion of the variant aspect, the improvement is expected to be limited to three years. Up until now, this research is proceeding as planned.

Now that for the first time sandy soil is included in the experiments, new findings have been achieved regarding scabies and Rhizoctonia. Because a wider effect of tillage application is now known, this comes as no surprise. The solution lies in applying appropriate tillage times in a balanced way, as was also originally advised and this does not change. On sensitive soils however it is of great importance to apply the method from the earliest time of reproduction. The appearance of scabies and Rhizoctonia should be an indication to breeders of which tillage times to use in the following year.

PARTICIPANTS PROJECTS MDM AND PADGG**Potato breeders PADGG 2006**

Jan Zenhorst - Creil
Joost van Strien - Ens
Evert Rienks - Dronten
Herman Vermeer - Swifterband
Jaap Vermeer – Swifterband.

Potato breeders MDM 2005 - 2006

Pieter Van Bentum - Vught
Frans van Laer - Breda
Arie de Winter – Oostvoorne.

Other participants

PPO Lelystad en PPO Westmaas, Agrico Bant,
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