Tuber development rates of six potato varieties in organic farming in Osnabrück, Germany

ULRIKE SCHLIEPHAKE[1], DIETER TRAUTZ

Key words: tuber development, tuber bulking, potato, organic farming

Abstract

The tuber development of the varieties used is closely related to the maturity groups. Some variety differences within the maturity groups exist. If the development of the yield after a planned harvest (a date between 75.th and 80.th day after planting is recommended) is satisfactory and no further yield formation is expected then it is not necessary to spray any supplements against Late Blight (Phytophthora infestans).

Introduction

Little is known about the variety characteristics of potato in organic farming. All field experiments so far had been carried out by conventional farmers with the possibility of applying chemical-synthetic pesticides and mineral nitrogen fertilizers. Those results are published every year in the German National Listing of Potato varieties (BUNDESSORTENAMT, annual). But a lot of variety characteristics –important for organic farming- are not included in this catalogue and so for many years farmers have been demanding field trials with grain and potatoes in organic farming to fill the gaps. (HUSS, 2006) Despite the importance of potato tubers as a source of food, the growth and development of tubers had not been measured. Therefore, a national organic field trial with 18 varieties and in 7 locations was carried out from 2009-2012. Knowing the dynamic of tuber development it seems easier to manage Late Blight (*Phytophthora infestans*), because this disease is responsible for a restricted yield, especially in organic farming, with permitted supplements. Some research about bulking rates of potatoes (Russet Burbank) with several objective targets like irrigation and/or Nitrogen Management (conventional trials) can be found, but no research based on modern German or European varieties could be found neither in conventional or in organic farming. (BOHL et al. 2006 and BELANGER et al. 2001)

Material and Methods

A four year tuber bulking rate study was conducted at the experimental organic farm of the University of Applied Sciences in Osnabrueck, Germany. The randomized plots consisted of four 5 meter rows spaced 75 cm apart with a seed piece spacing of 33 cm, using sixteen plants per variety with four replications. The plots were harvested after 70 (T1), 80 (T2) and 90 (T3) days of planting. After approximately 125 days (F) the plots were finally harvested. At each harvest the tubers were quantified (weight and number of tubers) and divided into different grading sizes (<30/35 mm, 30/35 – 55/60 mm and >55/60 mm) depending on tuber shapes, weighed again and the number of tubers were counted.

Two varieties of every maturity group with the highest planting relevance in organic farming in Germany were chosen for this paper, their characteristics can be found in Table 1.

Table 1: Characteristics of the used varieties

Characteristics/Variety	Annabelle	Anuschka	Belana	Princess	Ditta	Allians
Breeder	Weuthen	Europlant		Solana	Europlant	
Maturity	Very early		Early		Medium Early	
Tuber Shape	Long	Round	Oval		Long-oval	
Yield	Below average	More over-sized tubers	Average			High

[1] University of Applied Sciences Osnabrück, Faculty of Agricultural Sciences and Landscape Architecture,
Am Krümpel 31, 49090 Osnabrück, Germany, www.hs-osnabrueck.de, Email: u.schliephake@hs-osnabrueck.de

Results

Figure 1 shows the tuber development from Time harvest 1 (T1) to Final yield (F). Both very early varieties Annabelle and Anuschka have a higher marketable yield until Time harvest 3 (T3) compared to the others. The amount of undersized tubers in theses varieties is less than the later varieties.

The very early varieties Belana and Princess have a higher yield from the beginning but the yield development flattens out towards harvest T3.
The medium early varieties Ditta and Allians start with a moderate yield but over time develop the highest marketable yield by the end.
The all-over yield (undersized + oversized + marketable yield) at Final harvest indicates that Anuschka has a significantly higher yield than Annabelle, Belana and Princess. Ditta and Allians have significantly better yields than Annabelle. The reduction of yield between T3 and Final harvest in Annabelle, Belana and Princess may be attributed to tuber decay for several reasons, such as the earlier decline of the vines and the reduction or decay of tubers due to drought stress or in the case of Annabelle due to tuberrot.

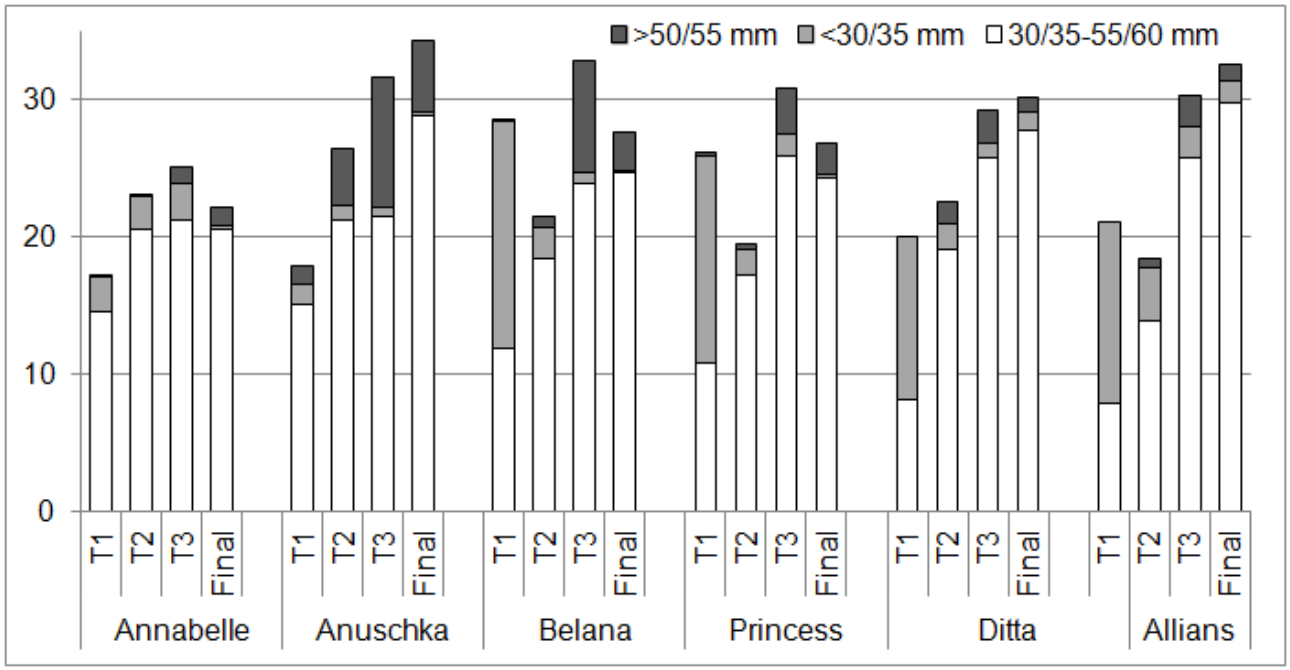

Figure 1: Tuber development in t/ha from harvest T1 to Final harvest, 4-year-medium, Undersized yield (<30/35 mm), Oversized yield (>55/60 mm) and Marketable yield (30/35-55/60 mm) (grading depends on Tuber Shape, Table 1)

Table 2: Marketable Yield (4-year-medium) depending on Harvest Times (different letters indicate significances (p=0,05), BONFERRONI)

Variety	Maturity Group	T1 (Day 70)	T2 (Day 80)	T3 (Day 90)	Final (Day 125)
		T ha^{-1}	T ha^{-1}	T ha^{-1}	T ha^{-1}
Annabelle	Very early	14.5 a	20.5 a	21.2 a	20.5 a
Anuschka		15.1 a	21.2 a	21.6 a	28.9 bc
Belana	Early	11.9 ab	18.4 ab	23.9 a	24.3 ab
Princess		10.8 ab	17.2 ab	25.9 a	25.0 ab
Ditta	Medium Early	8.2 b	19.1 ab	25.8 a	27.8 bc
Allians		7.9 b	13.9 b	25.8 a	29.3 c

T1: Allians has at T1 a significantly more undersized yield than the other varieties, except Princess. Anuschka shows a significantly higher yield of oversized tubers. Allians and Ditta have a higher marketable yield than Annabelle and Anuschka. There is a difference between very early and medium early varieties concerning the marketable yield.

T2: Again, Allians has a more undersized tuber yield and Anuschka more oversized tuber yield than the other varieties. Both Annabelle and Anuschka have a higher marketable yield than Allians. At this time the difference between the maturity groups in marketable yield is not clear, only Allians as a medium early variety shows a difference from Annabelle and Anuschka (very early). Within all other varieties no differences exist.

T3: Anuschka has asignificantly less undersized tuber yield than Annabelle, Princess and Allians. Ditta has less undersized tubers than Annabelle. Similarly to the harvest 10 days before, it is only Anuschka that has significantly more oversized tubers than the other varieties. While the yield of the very early varieties could not be extended further, it is now apparent that the early and medium early varieties have an increased yield from T2 to T3 of approximately 5.5 t/ha (Belana) to 11.9 t/ha (Allians). All varieties show no differences in marketable yield.

Final: The medium early varieties Ditta and Allians have more undersized tubers than all the others. Anuschka still has more oversized tubers than all the others. Anuschka, Ditta and Allians have a higher marketable yield than Annabelle. Allians shows a significant higher yield than Belana and Princess. With the exception of Anuschka there is a marketable yield difference between the maturity groups.

Discussion

Infections with Late Blight are usually detected in the first week of July, when the tubers are in full bulking process. In Germany, this is around the planned third harvest approximately 80 days after planting. With the restricted use of supplements against Late Blight in Organic Farming it is important to know how much marketable yield the varieties have developed until this date. This is an important factor for economic success.

Figure 2 compares the marketable yield from harvest T1 to Final Harvest with the Final harvest (=100%) of every variety.

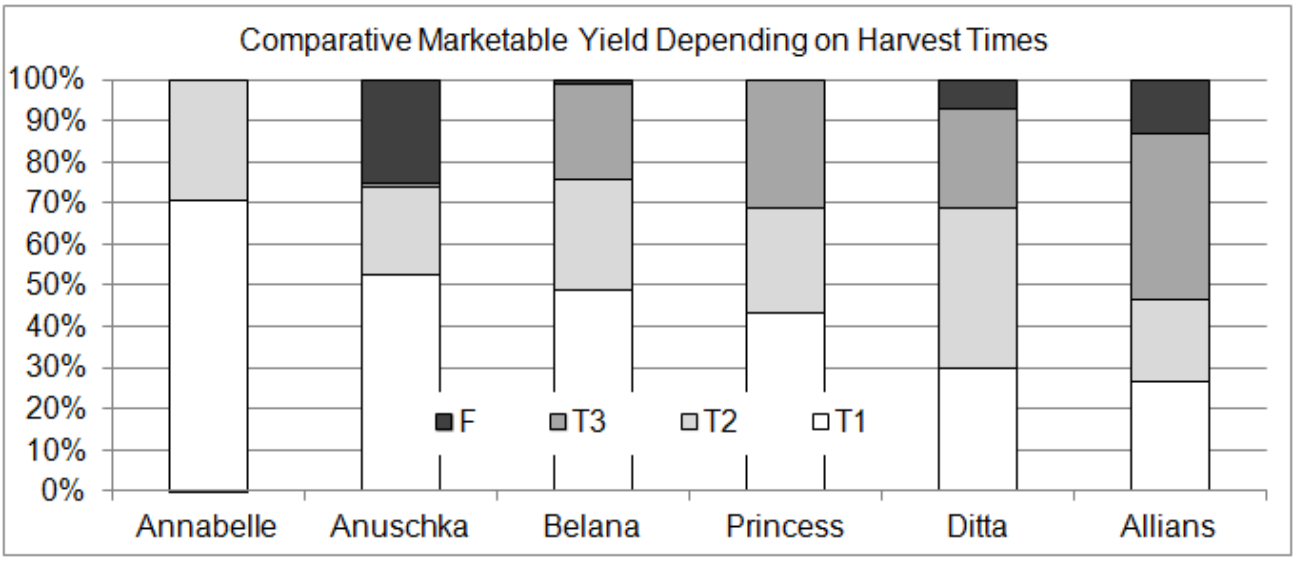

Figure 2: Comparative Marketable Yield Depending on Harvest Times from T1 (70 days), T2 (80 days), T3 (90 days) and Final (125 days)

70 days after planting (T1) only Annabelle has a higher marketable yield (71 %) than the others as predicted due to its very early maturity and already reaches its Final yield at T2. Anuschka in contrast has a later yield

development and reaches 74 % of its Final yield at T2. Anuschka builds almost 25 % of its Final yield in the last period from T3 to final harvest. The vine decline affects Annabelle only.

Belana seems to be a little faster in tuber development than Princess in the same maturity group. Similarly to Anuschka, both varieties reach the same yield as Annabelle at T2. While Princess has more yield development from T3 to Final harvest, the yield development of Belana is constant from T1 to T2 to F.

Ditta and Allians show poor yields at T1 compared to the other varieties as was expected. They belong to the early maturity group. Ditta has a similar yield at T2 to Anuschka, Belana and Princess. Allians reached only 47 % of the Final yield at this time. From T2 to T3 the yield increased around 31 % (Ditta), but 53 % for Allians.Up to the Final harvest the yield development of Ditta is about 7 % and in Allians about 13 %. In conclusion Allians has the slowest yield development of all varieties used in this paper and would need some permitted supplements against Late Blight.

References

Bundessortenamt (2013): Beschreibende Sortenliste Kartoffeln, Hannover

Belanger G, Walsh JR, Richards JR, Milburn PH, Ziadi M (2007): The Growth and Biomass Partitioning of Two Potato Cultivars Grown under Different N Fertilization Rates With and Without Irrigation, In: American Journal of Potato Research 78, 109-117

Bohl WH, Love SL (2006): Understanding Tuber Bulking Rates of six Potato Varieties; Presented at the Idaho potato Conference on January 18

Huss H (2006): Die Bedeutung der Krankheitsresistenz im Biologischen Pflanzen-schutz. In: Bericht Österreichische Fachtagung für Biologische Landwirtschaft, Teil Bio-Sorten-Wertprüfung für Ackerkulturen; 21.-22.März 2006, HBLFA Gumpenstein