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EFFECT OF PHOTOPERIOD ON VEGETATIVE DEVELOPMENT AND TUBER FORMATION IN TWO POTATO VARIETIES

by

E. C. WASSINK AND J. A. J. STOLWIJK

(Laboratory for Plant Physiological Research, Agricultural University, Wageningen, Netherlands; 112th Communication)

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§ 1. INTRODUCTION

Extensive work has been done on photoperiodism of the potato. The literature on this subject has been reviewed *e.g.* by DRIVER and HAWKES (1). Recently, POHJAKALLIO (2) published the results of an investigation in Finland. Several varieties including F1 clones from a cross between *S. demissum* and *S. tuberosum* were used. The short day plots were shaded during part of the day. From the results it was concluded that in *S. tuberosum* long day had little effect on the onset of tuber formation. Long day had a positive effect on yield if the growing season was sufficiently long. It is supposed that the start of the tuber formation is photoperiodically sensitive, but that after this start the energy economy determines the yield. These conclusions are in general accordance with results obtained by WERNER (3) and several other investigators.

The interpretation of previous work in this field is sometimes difficult, because of the widely divergent methods which have been used. The large number of varieties, and the differences in climatic conditions at the experimental sites cause additional difficulties in interpretation. Two methods have been used to obtain long and short days. In one method, the potatoes are grown in summer, and some plots are darkened during part of the day. The short day plots thus receive considerably less light energy than the long day plots. This loss of potential photosynthesis is difficult to evaluate in comparisons of tuber yield, total weight and development. In another method potatoes are grown in greenhouses during winter, and the long day plots receive supplementary light. Since potatoes require rather high light intensities for normal development, plants grown under greenhouse conditions during winter are not directly comparable to plants obtained under field conditions in summer.

The time of lifting is very important, since potatoes usually mature earlier in short days than in long days. It would seem that this point has not always received sufficient attention.

In the present investigation, we have aimed at studying the effect of day length on tuber formation, and other formative features in two potato varieties. We have set up three parallel series, in which all plants received summer day light during a certain period of the day. Besides a series receiving the natural day

length, two other series have been run, which constituted the actual experiment. In one of these series the natural day was reduced to 10 hours, in the other one the natural day was also reduced to 10 hours, and then extended with 8 hours of weak artificial light. In this way we hoped to avoid objections resulting from differences other than those in day length between the short and long day plots, especially differences in the amount of photosynthetic energy and in night temperature.

Five liftings were made in the period from soon after the onset of tuber formation until the sprout system had died completely.

§ 2. MATERIAL AND METHODS

Two potato varieties have been used, *viz.*, 'Bintje', a fairly early variety, and 'Alpha', a late one. The seed potatoes were selected for uniform weight (50 gram for tubers of 'Bintje', 60 gram for tubers of 'Alpha'), and planted on 1-5-52. The soil was a loamy sand, without artificial manure. Each variety was planted in four plots of 2 × 2.5 metres, each plot containing 20 plants at distances of 50 × 50 cm. Every plot was surrounded by side rows of the same variety. The treatments given to the plots were as follows:

A. Day light from 7.00–17.00 h.
B. Day light from 7.00–17.00 h., additional light from 'day light' fluorescent tubes from 17.00–1.00 h. at an intensity of 120–150 Lux.
C,D. Natural day, at either side of the experimental plots.

The plants in treatments A and B were screened by light tight houses, 2 × 2.5 × 1.5 m, wheeled over the plots. In treatment B each house was equipped with 2 'day light' 40 W fluorescent tubes for supplementary light.

As already remarked, the actual experiment was the comparison between the series A and B. Series C and D were included to have 'normal' plants at hand, as a basis of comparison for the appearance of the short day plants and those under extended day. It was, of course, clear beforehand that they could not be directly compared with the A and B plants as to tuber formation and yield, since they received much more light energy per daily cycle.

All dark houses were equipped with a 25 W fan to avoid differences in night temperature between the A and B plots. In this way these differences were kept within 0.2 °C. Of course, equality of night temperature between the plots A,B and C,D could not be supposed, for the following reasons. Series A and B were covered daily when there is still bright sunshine on many summer days, so that the temperature during the rest of the day is likely to differ somewhat. Also the nocturnal reradiation of heat is likely to differ in the covered plots A and B, and the non-covered plots C and D. It turned out that, as a rule, the differences were less than 2 °C. In cases of rainfall during the night, the covered plots were sprayed to eliminate this difference.

The treatments started on 28-5-52 when the plants had overcome the differences in emergence and showed up homogeneously. From all series groups of 4 plants were lifted at intervals to be analized for total fresh weight and dry weight and distribution of this weight over the plants. After each periodical lifting of four plants out of every plot, the plants were weighed and the fresh weights of the above ground part, the under ground part, the new tubers and the roots were determined separately. A representative plant from every plot was analyzed for dry weight.

§ 3. EXPERIMENTAL RESULTS

A. *Effect of photoperiod on weight and weight distribution during the growing season*

The results of the fresh weight determinations for 'Bintje' have been given in Table I, for 'Alpha' in Table II. Some of the data have been represented in figs. 1 and 2.

Fig. 1 shows fresh weights of 'Bintje': total weight, tubers, and above ground parts for the various successive harvests, for short day, long day and natural day plants. The following characteristics may be mentioned:

The general trend of total fresh weight, tuber weight, and weight of the above ground parts shows the same features during the season for all day length series. Above ground and total weight first show an increase, then a decrease owing to dying of the above ground parts. Tuber weight increases steadily up to the final value, obviously however, with decreased speed when the plant is seriously dying. It is very marked, moreover, that the short day has decreased the length of the growing season, the optimum weights are reached earlier, and remain lower, in brief: the plants remain smaller. Notwithstanding this, the tuber weight of this series is highest of all in the first harvest, showing that the tuber formation has started earlier. It should be observed that the total weight, up to about the second harvest, is much the same in the long and short day series; they receive the same duration of solar irradiation which seems to yield much the same matter production. Only lateron, the larger size and the prolonged devel-

TABLE I

Fresh weight and fresh weight distribution of 'Bintje' in grams per 4 plants

Date	Number of days after planting	Series	Total weight	Above ground weight	Under ground weight	Old tuber	New tubers	Roots
17-6-'52	47	A	2253	1274	951	192	627	135
17-6-'52	47	B	2327	1580	735	219	332	196
17-6-'52	47	C	2932	2112	826	238	316	272
17-6-'52	47	D	2461	1592	869	218	439	230
27-6-'52	57	A	3157	1416	1740	142	1499	99
27-6-'52	57	B	3048	1806	1227	45	1000	182
27-6-'52	57	C	4305	2707	1572	136	1180	256
27-6-'52	57	D	3130	1585	1535	90	1249	196
3-7-'52	63	A	2844	1146	1694	138	1488	79
3-7-'52	63	B	3532	1792	1728	51	1523	154
3-7-'52	63	C	4476	2566	2074	97	1748	264
3-7-'52	63	D	3528	1578	1938	36	1730	164
18-7-'52	78	A	2928	725	2199	–	2125	74
18-7-'52	78	B	4563	1666	2883	–	2728	155
18-7-'52	78	C	5988	2395	3602	–	3390	212
18-7-'52	78	D	4580	1571	3018	–	2840*	178
31-7-'52	90	A	2754	–	2754	–	2514	240
18-8-'52	108	B	3208	–	3208	–	2914	294
26-8-'52	116	C	4120	–	4120	–	3910	210
26-8-'52	116	D	4705	–	4705	–	4386	319

opment of the above ground parts result in higher weights. The natural day series show much the same morphogenetic and seasonal development as the long day series, only the absolute weights are consistently higher throughout the season, obviously due to the considerably larger amount of solar radiation received daily. The last harvest was taken when the above ground parts had died completely.

Fig. 2 shows the same for 'Alpha'. The general similarity of fig. 1 and fig. 2 is obvious. Both varieties are similarly affected by the differences in 'day length'. Also here the short day series shows a considerable decrease in the duration of the growing season, whereas the tuber formation starts earlier: at the first harvest the development of these plants is the best of all, especially owing to the fact that tuber formation was by far most developed in this series (see also photo 3). The features discussed for 'Bintje' are even more pronounced in 'Alpha'. It should be observed that in the 1952 experiment, the natural day series died much earlier (shown by a strong decrease of total fresh weight by dying and drying of the above ground parts) than the long day series, and, correspondingly, reached a lower, even very much lower weight. Of course, the number of plants per harvest is too small to exclude erratic variations, and the magnitude of the effect may well be exaggerated.

In 1953 we tested some earlier and later varieties as well (about which we will report elsewhere), and we included 'Bintje' and 'Alpha' again as references. These data are not yet completely evaluated, but they show that the general trends, discussed above, are the same, as in 1952, except this last mentioned observation with 'Alpha'. In the 1953 experiment, the natural day series shows a

TABLE II

Fresh weight and fresh weight distribution in 'Alpha' in grams per 4 plants

Date	Number of days after planting	Series	Total weight	Above ground weight	Under ground weight	Old tuber	New tubers	Roots
23-6-'52	53	A	3143	1909	1217	246	846	133
23-6-'52	53	B	2506	1845	657	241	167	255
23-6-'52	53	C	2316	1483	835	183	426	230
23-6-'52	53	D	3255	2428	829	280	286	265
7-7-'52	67	A	3828	1755	2057	76	2074	95
7-7-'52	67	B	3856	2127	1723	53	1484	185
7-7-'52	67	C	4000	1832	2152	108	1843	201
7-7-'52	67	D	5887	3499	2267	126	1983	260
22-7-'52	82	A	4528	1259	3256	–	3136	120
22-7-'52	82	B	5061	2505	2555	–	2301	254
22-7-'52	82	C	4369	1683	2687	–	2465	222
22-7-'52	82	D	6734	3290	3425	–	3088	337
5-8-'52	96	A	3593	426	3147	–	3083	64
5-8-'52	96	B	5818	2246	3545	–	3316	229
5-8-'52	96	C	5374	1704	3645	–	3456	189
5-8-'52	96	D	7768	3393	4341	–	4072	268
11-8-'52	103	A	3640	–	3640	–	3493	147
2-10-'52	155	B	6488	–	6488	–	5870	618
24-9-'52	147	C	3730	–	3730	–	3516	214
18-9-'52	141	D	3240	–	3240	–	2858	382

more favorable final dry weight than the long day series, much in the same way as was found with 'Bintje' in both years. Thus, the above discussed observation of 1952, in which 'Alpha' in the long day finally comes out more favorably than in the natural day, requires a special explanation. It is either an exception due to a statistical error, or atmospheric differences between both years are responsible for it. It remains to be seen in later years wihch behaviour is the 'normal' one for this variety.

The photographs show the aspect of representative plants of a few harvests. Photo 1 a-c shows 'Bintje' at the first harvest date (on 17-6-52, 47 days after planting). In all series tubers have already developed, they are clearly biggest in the short day series. Photo 2 a-c shows 'Bintje' 10 days later. The smaller vegetative development of the short day series is now very apparent, and the other series have depassed it, also in tuber development. Photo 3, a-c, shows 'Alpha' at the first harvest date, 23-6-52, 53 days after planting. Tuber formation in the short day clearly surpasses that in the long day and neutral day series, in which it hardly has started. In photo 4 it is shown that 14 days later, tuber formation and vegetative development are both stronger in the long and natural day series than they are in the short day series. Photo 5 shows the 'Alpha' plot in the field on 17-6-52, with the dark houses. The houses are on rails and are wheeled over the plots at 5 p.m. and wheeled back at 7 a.m. During the night, the open spaces in front and back of the houses are covered with a screen. These screens can be seen lying on top of the houses. The right one is the long day one, the left one the short day one. Still more to the left, a part of one of the houses of the 'Bintje' plot is seen. Two side rows of 'Alpha' plants are clearly distinguishable in the space between the houses. Also the front row and the rear row are marginal rows which are outside the experiment and just serve for establishing equal conditions for all of the experimental plants. Behind the small screens in the top of the front side of the houses is the fan, in light-tight mounting.

Figs. 3 and 4 show the reaction of the plants to the various conditions in a particularly impressive way. Here we have plotted as percentages of total fresh weight, the above ground weight, and the total underground weight, differentiated in new tubers, old tubers, and roots, for each condition at each harvest date. On the abscissa, the plots are ordered, from left to right: short day, long day, natural day. Similar data in the various conditions have been connected by lines. (It should be noticed that the abscissa does not represent a quantitative scala, the plots are brought in simply at equal distances).

We notice that: 1) The general appearance of the 'Bintje' and 'Alpha' graphs is the same, and the various detailed features show up in much the same way during the season. Some of these features are mentioned under the following numbers. 2) The percentage new tuber weight increases during the season as may be expected, the fraction of the underground weight that is occupied by the new tubers increases also. 3) In the short day series, the underground weight, and especially the new tubers occupy a consistently larger fraction of the total weight than they do in the long day series. It is somewhat more pronounced in 'Alpha' than it is in 'Bintje'. 4) The underground weight fraction in the natural day is much the same as in the long day. 5) The above ground weight percentages, of course, show relations which are opposite of those listed under 3) for the underground weight percentages.

It must be emphasized that the intensity of the supplementary light was so low that no appreciable photosynthesis can have occurred during the additional

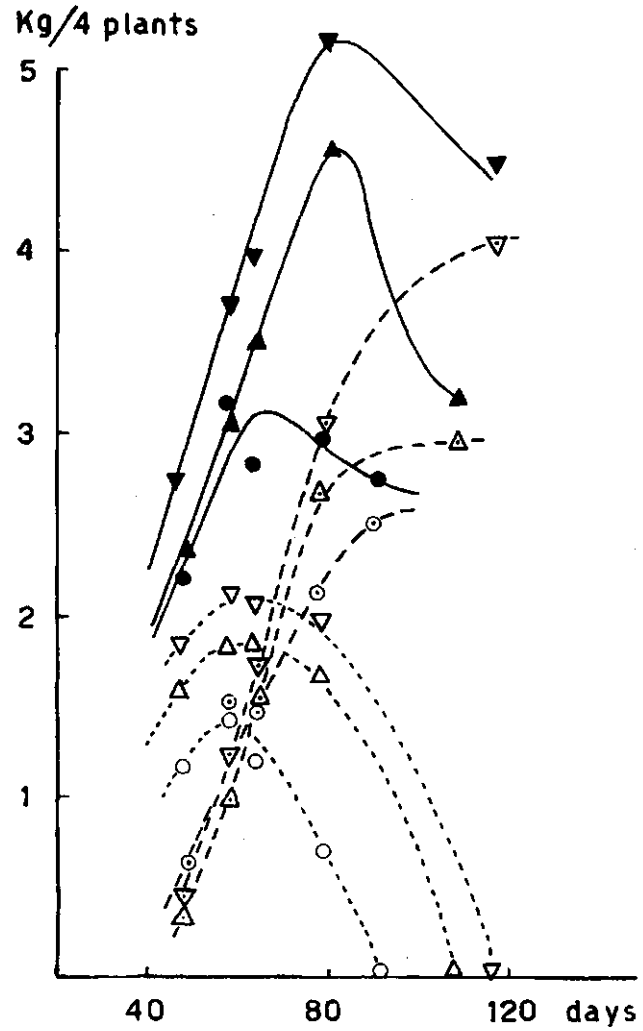


Fig. 1. Fresh weight and fresh weight distribution in 'Bintje' in successive harvests. *Total weight:* full drawn lines with black marks: ● short day ('A'), ▲ long day ('B'), ▼ natural day ('C, D'). *New tubers:* broken lines with dotted marks: ⊙ short day ('A'), ⩓ long day ('B'), ⩔ natural day ('C, D'). *Above ground weight (stems and leaves):* dotted lines with open marks: ○ short day ('A'), △ long day ('B'), ▽ natural day ('C, D').

light period. The differences observed between short and long day effects can only have resulted from the difference in day length.

Day length had no influence on the dry matter percentage of the tubers; the dry weight percentages increase during the growing period, and no differences can be observed in the final liftings (see Tables III and IV, in which also the dry weight percentages of other parts of the plants are collected). It should be noticed that the dry weight percentage of 'roots and foliage', consisting for the very much greater part of foliage (stems and leaves) shows very high values for the last liftings when the foliage had very much dried up.

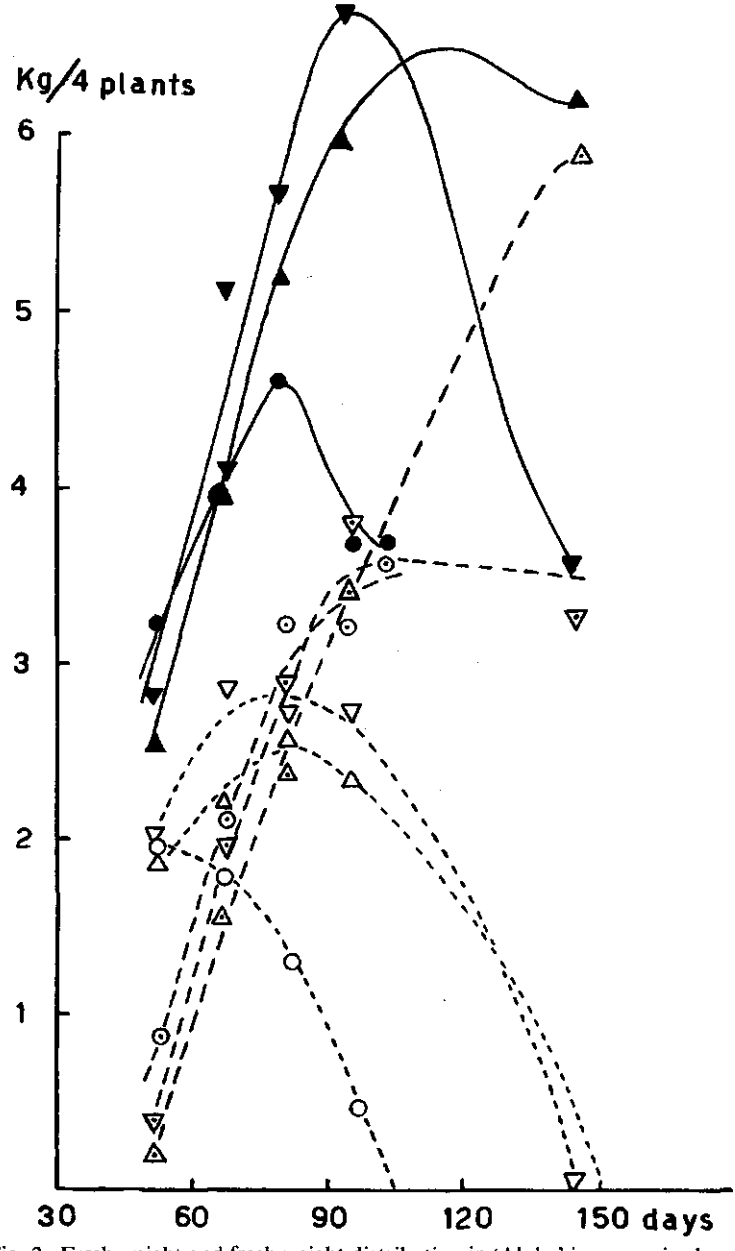


Fig. 2. Fresh weight and fresh weight distribution in 'Alpha' in successive harvests.
Legend: see Fig. 1.

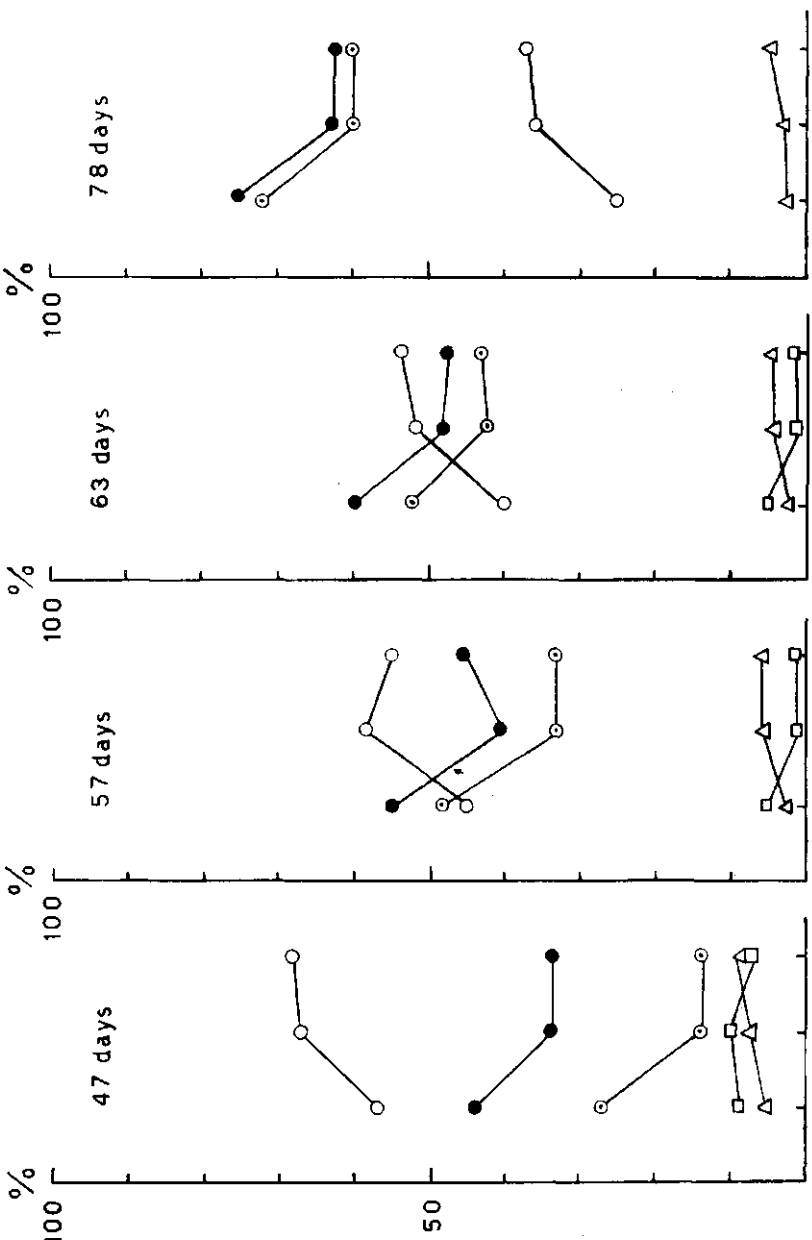


Fig. 3. Fresh weight distribution in 'Bintje' at successive harvests in the various treatments. Harvests 47, 57, 63 and 78 days after planting. A = short day, B = long day, C, D = natural day. ○ above ground weight, ● underground weight, from which ⊙ new tubers, △ roots, □ old tubers.

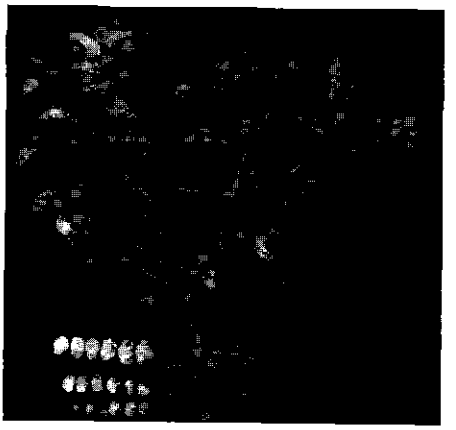
a

b

c

Photo 1, a–c. 'Bintje', first harvest, 47 days after planting; a: short day ('A'), b: long day ('B'), c: natural day ('C, D').

a



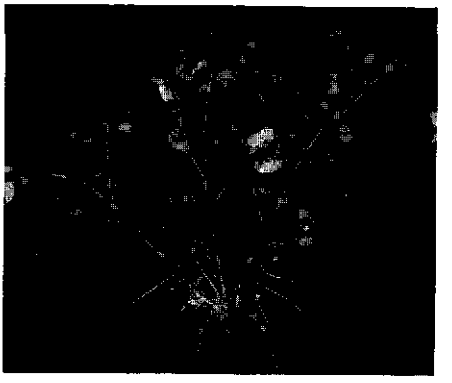
b

c

Photo 2, a–c. 'Bintje', second harvest, 57 days after planting; a, b, c as in photo 1.

a

b



c

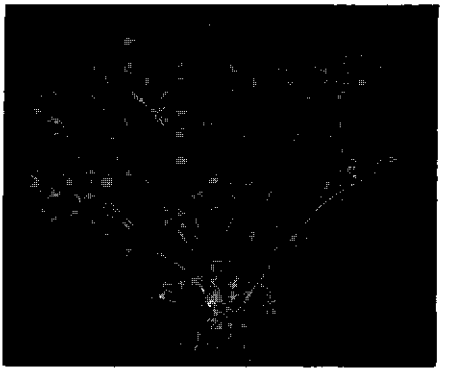
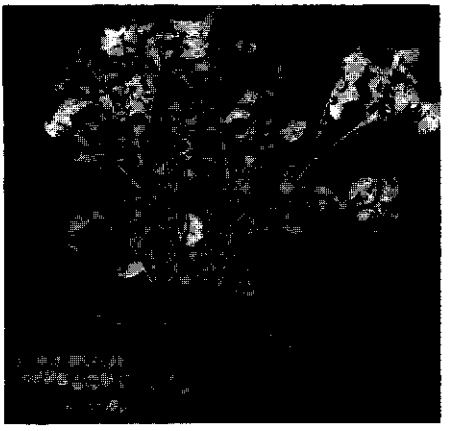


Photo 3, a–c. 'Alpha', first harvest, 53 days after planting; a, b, c as in photo 1.

a

b



c

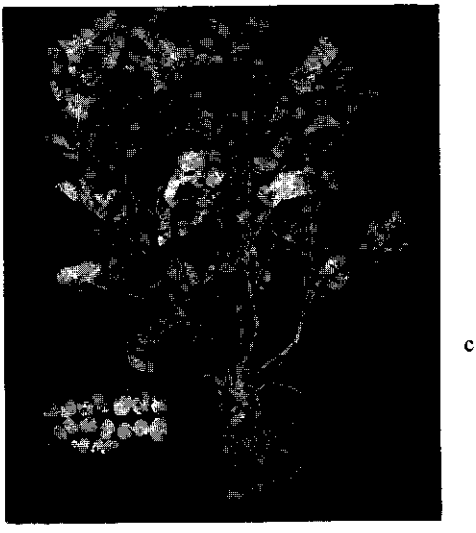


Photo 4, a–c. 'Alpha', second harvest, 67 days after planting; a, b, c as in photo 1.

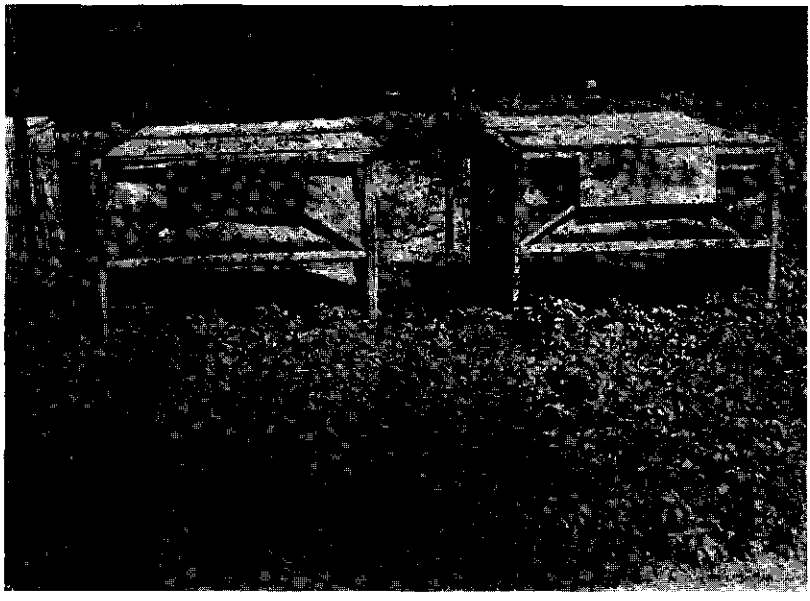


Photo 5. The plot of 'Alpha', with the cabinets, 47 days after planting, on 17-6-'52. Left: short day, right: long day. Between the rails of the cabinets: two marginal rows of 'Alpha' plants. See also text.

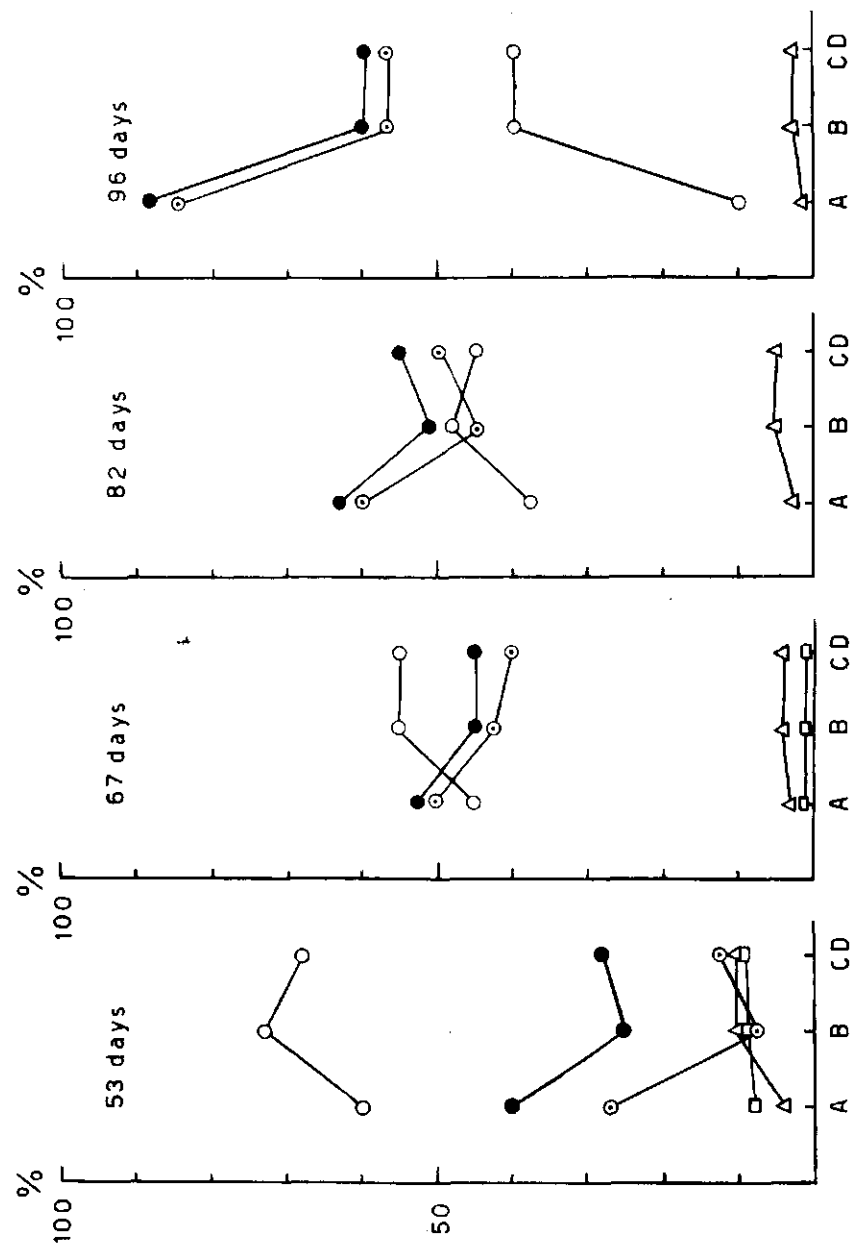


Fig. 4. The same as fig. 3, but for 'Alpha', after 53, 67, 82 and 96 days.

TABLE III *Dry matter content in 'Bintje' in percents*

Date	Number of days after planting	Series	Old tuber	New tubers	Roots + Foliage	Total
17-6-'52	47	A	2.1	14.9	7.9	9.6
17-6-'52	47	B	2.0	13.1	7.6	8.4
17-6-'52	47	C	2.1	13.1	7.1	7.4
17-6-'52	47	D	2.0	13.8	8.3	8.7
27-6-'52	57	A	2.4	16.5	7.0	10.3
27-6-'52	57	B	1.9	16.1	10.3	10.8
27-6-'52	57	C	2.1	14.6	6.2	8.2
27-6-'52	57	D	2.5	15.9	9.3	11.3
3-7-'52	63	A	3.8	17.3	7.8	12.6
3-7-'52	63	B	3.0	16.3	8.3	11.5
3-7-'52	63	C	2.6	15.6	7.3	11.5
3-7-'52	63	D	2.6	19.8	9.1	13.0
18-7-'52	78	A	–	20.0	8.1	14.7
18-7-'52	78	B	–	19.7	9.1	15.4
18-7-'52	78	C	–	18.5	10.9	15.2
18-7-'52	78	D	–	19.7	10.4	16.3
31-7-'52	90	A	–	19.3	15.0	18.7
18-8-'52	108	B	–	20.7	72.5	22.7
26-8-'52	116	C	–	22.0	34.9	22.9
26-8-'52	116	D	–	24.2	64.5	25.5

TABLE IV *Dry matter content of 'Alpha' in percents*

Date	Number of days after planting	Series	Old tuber	New tubers	Roots + Foliage	Total
23-6-'52	53	A	1.8	13.2	7.5	8.6
23-6-'52	53	B	2.7	12.8	8.1	7.6
23-6-'52	53	C	2.0	13.6	8.5	8.9
23-6-'52	53	D	1.8	12.1	7.7	7.4
7-7-'52	67	A	2.5	17.8	8.3	13.2
7-7-'52	67	B	2.1	17.5	9.4	12.4
7-7-'52	67	C	2.0	17.5	10.3	13.3
7-7-'52	67	D	4.0	15.3	9.4	11.0
22-7-'52	82	A	–	18.8	7.9	15.5
22-7-'52	82	B	–	18.5	9.4	14.0
22-7-'52	82	C	–	19.1	10.8	15.5
22-7-'52	82	D	–	18.6	8.7	13.2
5-8-'52	96	A	–	20.5	14.9	19.4
5-8-'52	96	B	–	20.7	11.7	15.8
5-8-'52	96	C	–	21.1	13.7	18.5
5-8-'52	96	D	–	19.7	11.5	15.8
11-8-'52	103	A	–	21.2	35.5	21.9
2-10-'52	155	B	–	21.0	14.1	20.0
24-9-'52	147	C	–	22.9	35.6	23.5
18-9-'52	141	D	–	18.9	68.0	21.2

B. *Effect of photoperiod on vegetative development*

From the data in the previous section it is evident that length of day has a pronounced influence on the vegetative growth of the potato plant. This was manifest in the field as a big difference in appearance. The short day plants were smaller in height and diameter as compared with the long day and natural day plants. The development of new leaves stopped very soon in short days. Notwithstanding the fact that the plants were completely healthy, their colour was yellowish green, especially at the top, as compared with the normal, darker green long day plants.

Data on stem development are given in Table V, and on the number of leaves on various dates in Table VI. These two tables show clearly that the above ground part of the long day plants is superior to that of the short day plants, and that the difference becomes greater as the plants grow older. This was observed in both varieties, but 'Alpha' is more marked in its reaction than 'Bintje'. The increase of the difference between short and long day plants is due to the fact that the short day plants reach their maximum development earlier and thus at a lower production of leaves and stems, after which decay sets in earlier also. It

TABLE V *Effect of day length on stem growth in 'Bintje' and 'Alpha'*

'Bintje'				'Alpha'			
Number of days after planting	Treatment	Average stem length cm	Number of stems per plant	Number of days after planting	Treatment	Average stem length cm	Number of stems per plant
47	short d.	35	6.5	53	short d.	45	4.25
47	long d.	49	6.5	53	long d.	44	4.5
57	short d.	36	5.75	67	short d.	45	3.5
57	long d.	55	5.75	67	long d.	61	6.0
63	short d.	36	4.0	82	short d.	41	2.75
63	long d.	64	4.0	82	long d.	59	5.25
78	short d.	35	5.0	96	short d.	44	3.25
78	long d.	62	4.5	96	long d.	66	4.5

TABLE VI *Effect of length of day on the number of leaves in 'Bintje' and 'Alpha'*

'Bintje'				'Alpha'			
Number of days after planting	Treatment	Number of leaves per plant		Number of days after planting	Treatment	Number of leaves per plant	
		> 10 cm	< 10 cm			> 10 cm	< 10 cm
47	short d.	53	13	53	short d.	45	11
47	long d.	47	25	53	long d.	51	23
57	short d.	48	8	67	short d.	40	6
57	long d.	75	19	67	long d.	62	26
63	short d.	38	7	82	short d.	29	2
63	long d.	47	9	82	long d.	72	19
78	short d.	28	3	96	short d.	25	0
78	long d.	44	9	96	long d.	60	25

follows from Tables V and VI that at the first harvest date the difference is small and possibly even somewhat in favour of the short day series.

Day length also has a marked influence on the aspect of the underground part of the plants as is shown in Table VII. The average weight per individual tuber towards the end of the season is much greater in long days in both varieties. In 'Bintje' this increase in weight per tuber in long days is accompanied by a slight reduction in the number of tubers per plant so that no big difference in total tuber weight in long and short days arises. In 'Alpha', however, the number of tubers in long and short days is much the same, so that the difference in weight per tuber results in a considerable difference in total tuber weight per plant in long and short days. It should be observed that initially the difference is strongly in favour of the short day series, and only after 63 days in 'Bintje', and somewhere about 75 days in 'Alpha', the position is shifted to the other side. Table VII also gives the total lengths of stolons in cm., per plant. With respect to stolon length both varieties react in the same way. In the short day plants the stolons are only about $\frac{1}{3}$ to $\frac{1}{2}$ as long as in the plants under long day conditions (cf. also 4).

TABLE VII

Average weight per tuber in grams and average total length of stolons per plant in cm in 'Bintje' and 'Alpha', as affected by length of day

'Bintje'					'Alpha'				
Number of days after planting	Treatment	Total stolon length cm	Average weight per tuber	Number of tubers	Number of days after planting	Treatment	Total stolon length cm	Average weight per tuber	Number of tubers
47	short d.	65	10.6	15	53	short d.	85	15.7	13
47	long d.	153	7.1	12	53	long d.	183	6.4	6
57	short d.	59	21.7	17	67	short d.	66	42.3	12
57	long d.	138	14.7	17	67	long d.	164	35.2	10
63	short d.	38	28.6	13	82	short d.	78	57.9	13
63	long d.	163	27.1	14	82	long d.	191	46.0	12
78	short d.	46	30.3	18	96	short d.	53	63.8	12
78	long d.	151	40.7	16	96	long d.	184	82.8	10
90	short d.	–	26.6	17	103	short d.	–	57.2	15
108	long d.	–	54.0	13	155	long d.	–	96.3	15

C. *Effect of photoperiod on flowering*

At each periodical lifting the plants were examined for flower buds and flowers. The data obtained in this way have been given in Table VIII. It can be concluded that both varieties react as long day plants with respect to flowering. In both varieties a greater number of flower buds and flowers is observed in the plants under long day conditions. However, no open flowers were observed at all in 'Bintje' and only a few in 'Alpha'. This is due to the fact that, besides photoperiod, a number of other factors regulate flowering in many commercial varieties; it is well known *e.g.* that 'Bintje' only flowers satisfactorily for breeding purposes when appropriate precautions are taken.

Of course, this complication, together with the fact that the number of plants at our disposal was insufficient for microscopical dissection, makes it very difficult to draw any conclusions except very general ones about the effect of photoperiod on flower formation in this experiment.

TABLE VIII

Flower development in 'Alpha' and 'Bintje', as affected by day length (p. plant)

Variety	Treatment	Number of days after planting	Number of vegetative growing points	Just visible flower buds	Flower buds	Flowers	Abscissed bud or flower
Bintje	short d.	47	24	1	–	–	–
		57	5	10	–	–	–
		63	8	8	–	–	–
		78	7	3	–	–	–
Bintje	long d.	47	2	12	11	–	–
		57	1	8	14	–	–
		63	2	–	11	–	–
		78	–	2	4	–	4
Alpha	short d.	53	15	2	–	–	–
		67	3	11	–	–	–
		82	5	5	–	–	–
		96	–	–	–	–	–
Alpha	long d.	53	7	3	13	–	–
		67	–	3	14	3	–
		82	–	2	5	1	9
		96	–	6	11	–	6

§ 4. DISCUSSION

Both potato varieties under investigation show more or less the same reaction to day length, although differences exist, especially in the degree of reaction. A general phenomenon is the short vegetation period under short day conditions. The above ground parts bring their development to a closure much sooner than those of the plants under long day conditions. Thus, in short days, a smaller fraction of the photosynthates is used for the expansion of the photosynthetic apparatus, and relatively more is stored under ground in the form of tubers (see fig. 3 and 4). The photosynthates are directed to the underground parts in both long and short days, but under short day conditions this downward stream develops earlier and is stronger, coupled with an earlier standstill and a quicker decline of the development of leaves and stems.

From fig. 1 and 2 it is evident that there is some sort of a competition for dry matter between the above ground parts and the tubers, and any change in either of the two is reflected in the other. Pretty soon after tuber formation is well on its way, the above ground parts stop growing, and soon a gradual decline sets in.

In the varieties 'Alpha' and 'Bintje' the photoperiod has a distinct effect on the onset of tuber formation, but cannot prevent it, nor start it right away. It is conceivable that the formation of floral primordia or flowers decides over the onset of the decay of the above ground parts. However, if stolon length per plant is considered, it can be seen from Table VII that already in the first lifting, stolon length was strongly affected by length of day in both varieties. Since this difference appears much earlier and is more complete and more persistent than the difference in reproductive development, it must be assumed that stolon length is affected by the photoperiod in a much more direct way than via flower primordia.

More or less the same reasoning applies for the number of tubers formed, the

average individual tuber weight, and the total tuber weight. These data also contain an indication, that the reproductive development does not play the decisive role in the decay of the above ground parts.

§ 5. SUMMARY

Two potato varieties, 'Alpha', a late variety and 'Bintje', a fairly early variety, have been exposed to short and long days in a field experiment (Photo 5). Both long and short days consisted of a 10 hour period in day light, in the case of the long days followed by 8 hours supplementary light from fluorescent tubes at an intensity of about 120 Lux. In addition, series in natural day length were run.

Under short days, the vegetation period was shortened, the growth of the above ground parts reached its maximum sooner, and decay was quicker. Tuber formation started earlier, but did not reach the final value attained in long days (fig. 1, 2). At all harvests it was found that in the short day series the above ground parts made up a smaller percentage of the total fresh weight than in the long day and natural day series (figs. 3, 4, photo's 1–4).

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