THE POPULATION DYNAMICS OF APHIDS INFESTING THE POTATO PLANT WITH PARTICULAR REFERENCE TO THE SUSCEPTIBILITY OF CERTAIN VARIETIES TO INFESTATION

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INTRODUCTION

References to varietal differences in susceptibility of the potato plant to aphid infestations have appeared sporadically in the literature over a number of years. In 1932, WHITEHEAD *et al.* indicated that the variety *Kerr's Pink* was less susceptible to aphid injury than some other varieties under conditions where light infestations of both *Myzus persicae* SULZ. and *Macrosiphum euphorbiae* THOS. occurred. In the U.S.A. MAUGHAN (1937) reported wide variations in aphid populations on eleven varieties of potato, but he did not name the aphid species involved. BURNHAM and MACLEOD (1942) reported that the variety *Katahdin* was susceptible and killed by *M. persicae*, while *Up-to-Date*, *Green Mountain* and *President* were more resistant. ADAMS (1946) also found *Katahdin* to be "very susceptible" in comparison with 80 other varieties of potatoes and *Solanum* species which she tested. *Katahdin* is now used as a "standard" in Canada for comparing aphid infestations on other potato varieties both in the field and in the glasshouse (DIONNE, 1948). Although *Katahdin* is generally regarded as being very susceptible to *M. persicae*, other varieties may support larger populations of *Aphis nasturtii* KLTB. (= *A. abbreviata* PATCH) (BRADLEY, 1952; SIMPSON and SHANDS, 1949). Comparing the varieties *Katahdin*, *Chippewa*, *Canso* and *Keswick*, BRADLEY *et al.* (1952) found that similar infestations of *M. persicae*, *M. euphorbiae* and *A. nasturtii* developed on each. BALD *et al.* (1946) also found no evidence of aphids preferring any of the varieties they tested.

Growing plants at different fertilizer levels has given no clear indication of any relation between resistance to aphids and nutritional factors. On the one hand no reaction was found between aphid populations and fertilizer treatments (ARENZ, 1951; ROSS *et al.*, 1947; TAYLOR *et al.*, 1953; VÖLK and BODE, 1954; VÖLK *et al.*, 1952), while in other instances certain responses were indicated (BROADBENT *et al.*, 1952; HOFFERBERT and ORTH, 1948). Nevertheless, KENNEDY and BOOTH (1951) have shown, under a variety of circumstances, that *M. persicae* exhibits feeding preferences and TAYLOR (1955) concluded that selection of senescing leaves by *M. persicae* accounted for differences in maximum populations observed on five potato varieties. Aphid infestations are considered to be dependent on physiological changes in the host plant, whether environmentally or genetically controlled (TAYLOR, 1957). This is accepted

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as a premise for the present paper in which the population growth of three aphid species infesting the potato plant is examined in relation to the vegetative development of four potato varieties.

EXPERIMENTAL PROCEDURE

The four potato varieties chosen varied greatly in growth habit. All are well-established British commercial varieties.

Ulster Chieftain:	a low, compact plant, with large, thin, waxy leaflets; Early.
Arran Pilot:	of medium height, with strong stems and medium-sized leaflets; spreading habit towards maturity; Early.
Stormont Dawn:	fairly tall with strong stems and large, thick leaflets; leaves overlap giving good ground cover; Maincrop.
King Edward:	tall and erect; leaflets small, glossy and narrow; mature plant with sparse lower foliage but with crowded top growth; Maincrop.

The experiment was arranged in a 4 × 4 Latin square. Each plot consisted of 12 rows of 12 plants, with 28 in. (70 cm) spacing between rows and 18 in. (45 cm) between plants in the rows. Scotch seed "A" Certificate was used and in each year all tubers were planted on the same day. Normal cultivations were carried out in the preparation of the experimental area and subsequently during the growth of the crop, but care was taken to ensure that ridging-up and hoeing did not cover up any leaves. Soon after emergence above ground each haulm was pruned to a single stalk, and this operation was carried out, as necessary, throughout growth with the result that each tuber was represented by a single main stem with axillary shoots produced from the nodes. Differences between varieties were exhibited mainly in the amount of axillary growth, the maincrop varieties producing a greater number of axillary shoots, and thus a greater number of leaves than the early varieties (TAYLOR, 1953).

Aphid counts were made at approximately weekly intervals from the time the plants emerged until the senescent stage of growth, by which time few if any colonies remained. The sampling method was related to the growth of the plant and took into account differences in growth habits between varieties (see TAYLOR, 1953). Leaves were selected at random from five leaf-zones on the main stem, Basal (B), Lower (L), Middle (M), Upper (Tm) and Apical (Ty), and from lower, middle and upper leaf-zones on the axillary shoots. Axillary shoots were also classified according to the node on the main stem from which they originated. In this way distribution of aphid infestations may be interpreted in relation to the vegetative development of the plants.

Records of the main flight periods of the potato aphids were obtained by means of yellow water traps (MOERICKE, 1951). Each trap measured 76 cm square and 10 cm deep and was supported at a height of 75 cm from the ground. The data in FIG. 1 are from traps situated about 1000 m from the experimental plots and any other crops of potatoes. Traps placed within the crops caught many more potato aphids but no clear distinction could be made between spring and summer migrations due to the continuous activity of the alatae there from the time of the primary migration.

THE NORMAL COURSE OF THE INFESTATION

The investigations were undertaken during 1952 and 1953 at the University of Nottingham School of Agriculture. In most years in this Midlands area of England three species of aphids are common on potatoes. *M. persicae* is invariably present each year but the population may not always be large. *M. euphorbiae* is usually present and is abundant during warm, dry summers, when large numbers cover the tips of the growing shoots and infest the flower clusters. *A. nasturtii* is relatively scarce on potatoes in some years, but in others it may be so abundant in the crop that plants suffer directly from their feeding (FIG. 1, 1952).

In 1952 the plants became colonized by alatae early in June, although migrants had been found in the water traps from the middle of May onwards (FIG. 1). Large numbers of *A. nasturtii* soon appeared on the plants, and together with *M. persicae* and *M. euphorbiae*, the infestation built up rapidly until a peak was reached about 12 July. In 1953 migrant alatae were first found on the plants on 8 June, but, unlike events in 1952, counts of aphid populations showed little increase until the end of June, after which the population curves for *M. persicae* and *M. euphorbiae* were similar in form to those for 1952 (FIG. 1). Few alate *A. nasturtii* were trapped in 1953 and populations on the plants remained low throughout the season.

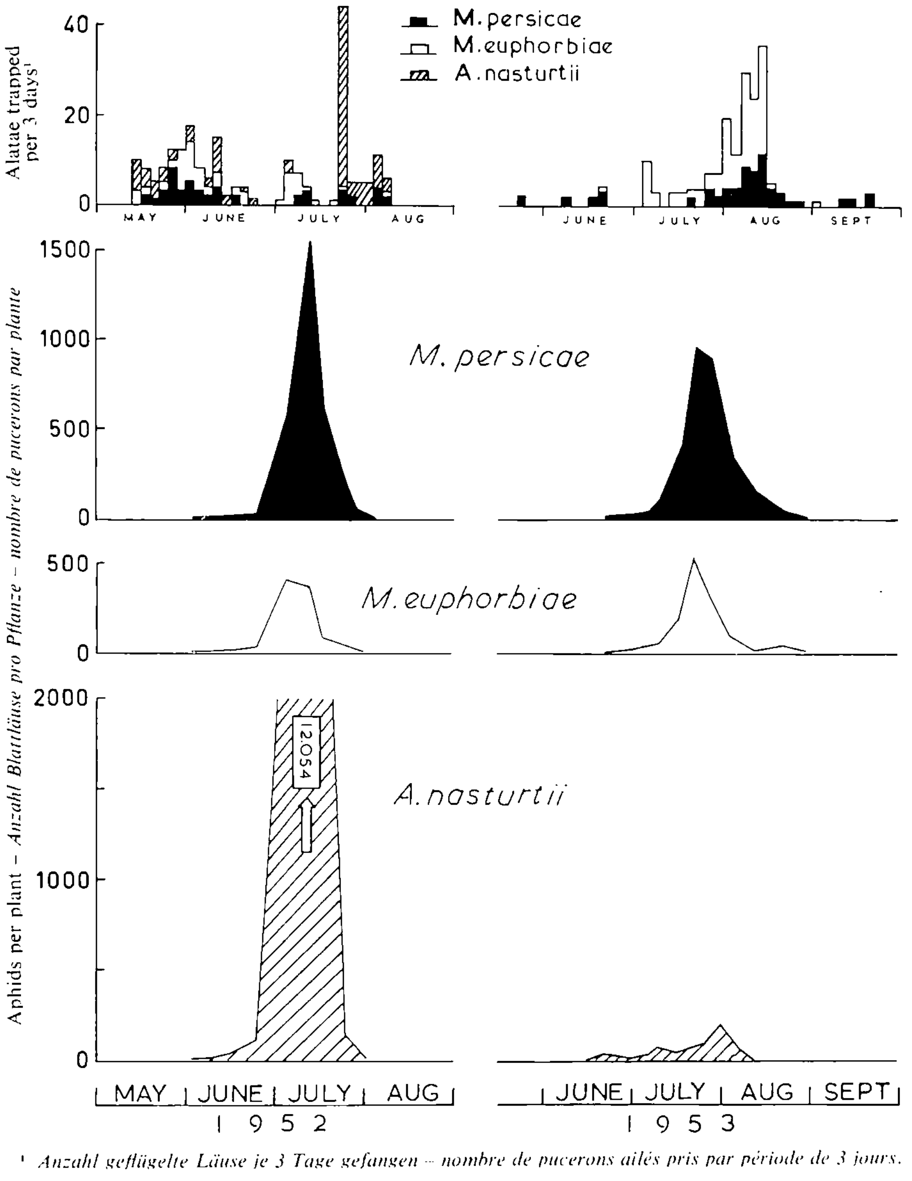
The population curve for each aphid species and in any season may be divided into three phases. The first of these is the initial colonisation phase in which alate migrants arrive on the plants and deposit larvae. It is denoted graphically by a low population level and apparently slow increase in population as compared with later stages. This phase ends with the maturation of the first generation of apterae, after which there is a rapid expansion in the population as the apterae begin to produce larvae. A population growth-rate approaching a geometric progression is maintained until the peak of the infestation is reached, after which maturation of the alatae produced on the plant leads to the decline in the infestation which marks the third phase. As indicated by SHANDS and SIMPSON (1959), the rise and decline of populations of all three species is represented by a typical sigmoid curve, the peak of which may vary much in height from year to year, but relatively little in time of occurrence.

In 1952 the initial colonisation phase was short, resulting partly from the high temperatures prevailing at the time, which led to rapid maturation of the larvae deposited on the plants, and partly from the large numbers of alatae comprising the spring migration and the consequent greater number of larvae deposited. In 1953 fewer migrants were found on the plants and temperatures were lower during the period of colonisation (FIG. 1).

INITIAL COLONISATION BY SPRING MIGRANTS

In 1952 trap records indicate that the spring migration of the three species of potato aphids continued from 16 May to 20 June, with a peak between 25 May and 10 June (FIG. 1). Alate migrants were first found on the potato plants on 2 June and subsequently until 23 June. During this period the plants were growing rapidly and by the

FIG. 1. Aphid infestation of the potato variety *King Edward*



¹ *Anzahl geflügelte Läuse je 3 Tage gefangen – nombre de pucerons ailés pris par période de 3 jours.*

ABB. 1. *Blattläusebefall der Kartoffelsorte* King Edward
FIG. 1. *Infestation de la variété de pommes de terre* King Edward

end of the migration period they were forming a good ground cover, although not touching each other across the drills. The progress of colonisation by the migrant alatae was examined by randomly selecting a number of plants of each variety during the period of the spring migration. The leaf type on which each species was found, was recorded, together with any new-borne larvae associated with them. Motherless colonies of 1st instar larvae of *M. persicae* were also recorded. No significant differences in aphid behaviour were recorded between the four potato varieties and the data in TABLE 1 are the pooled observations on all varieties.

TABLE 1. Deposition of alatae on the potato plant and sites of reproduction; 180 plants examined during the period of the primary migration 20 May to 20 June, 1952

		Position of leaf on main stem – *Blätterstand am Hauptstengel – emplacement de la feuille sur la tige principale*				
		B	L	M	Tm	Ty
M. euphorbiae						
	Ao	3	1	1	–	–
	Al	4	4	2	–	–
	Li	31	18	4	–	–
A. nasturtii						
	Ao	17	16	14	27	45
	Al	18	25	11	6	3
	Li	168	310	82	11	6
M. persicae						
	Ao	2	1	1	3	3
	Al	1	–	–	–	1
	Li	1	–	–	–	2
No. of groups of larvae – *Anzahl der der Larvengruppen – nombre de groupes de larves*		15	7	6	3	–
Total no. of larvae in the groups – *Gesamtzahl der Larven in den Gruppen – nombre total de larves dans les groupes*		35	12	7	4	–

Ao Alate adults without larvae – *geflügelte Erwachsene ohne Larven – adultes ailées sans larves.*
Al Alate adults with new-borne larvae – *geflügelte Erwachsene mit neugeborenen Larven – adultes ailées avec des larves nouveau-nées.*
Li Number of larvae – *Anzahl Larven – nombre de larves.*
B Basal – *basale Blätter – feuilles de base.*
L Lower – *untere Blätter – feuilles de la partie inférieure.*
M Middle – *mittlere Blätter – feuilles de la partie moyenne.*
Tm Upper – *obere Blätter – feuilles de la partie supérieure.*
Ty Apical – *Spitzenblätter – feuilles du sommet.*

TABELLE 1. *Das Einfallen der geflügelten Blattläuse auf die Kartoffelpflanze und Fortpflanzungsstellen: Untersuchung an 180 Pflanzen während der Periode der Frühjahrsmigration vom 20. Mai bis 20. Juni 1952*

TABLEAU 1. *La descente des pucerons ailés sur la plante de pomme de terre et endroits de multiplication; examen de 180 plantes durant la période du vol primaire de migration du 20 mai au 20 20 juin 1952*

From general observations of aphids flying in potato crops it seems that in most cases migrating alatae alight on the young leaves at the apex of the plant. In 1952, when *A. nasturtii* was abundant, it was possible to observe on several occasions, alatae alighting on the tip of the plant but these very soon moved downwards. In most cases migrants moved to the underside of the leaf soon after alighting and from there they crawled along the petiole to the main stem. Their wanderings eventually took them to the leaves at the base of the plant. JOHNSON (1958) observed similar behaviour with *Aphis fabae* SCOP. on *Euonymus europaeus*.

Alatae of *A. nasturtii* were found on all types of leaves, but the greatest numbers associated with newly-borne larvae were on the lowermost leaves and here the reproduction rate (measured by the ratio of larvae: adults) was greatest (TABLE 1). Nearly 50% of the alate migrants of *M. euphorbiae* were found on the basal leaves of the plants *i.e.* those lying in contact with the ground, and none on the young leaves. Later in the season, however, large numbers infested the flower cymes and young leaves. In 1953 few migrants were recorded but these were on the upper leaves of the plants; there was none on the lower leaves.

Very few alate *M. persicae* were found and these were more or less evenly distributed between young, mature and older leaves (TABLE 1). Migrants colonising potato plants usually stay long enough to deposit one or two larvae only, before flying to another plant in the crop, or flying away from the field. It is unusual, therefore, to find alate mothers with their progeny, but sites preferred for larviposition may be inferred from the position of the colonies of 1st instar larvae. From the data in TABLE 1 it can be seen that most of the groups of larvae and also the greatest total numbers were on the lower leaves of the plants.

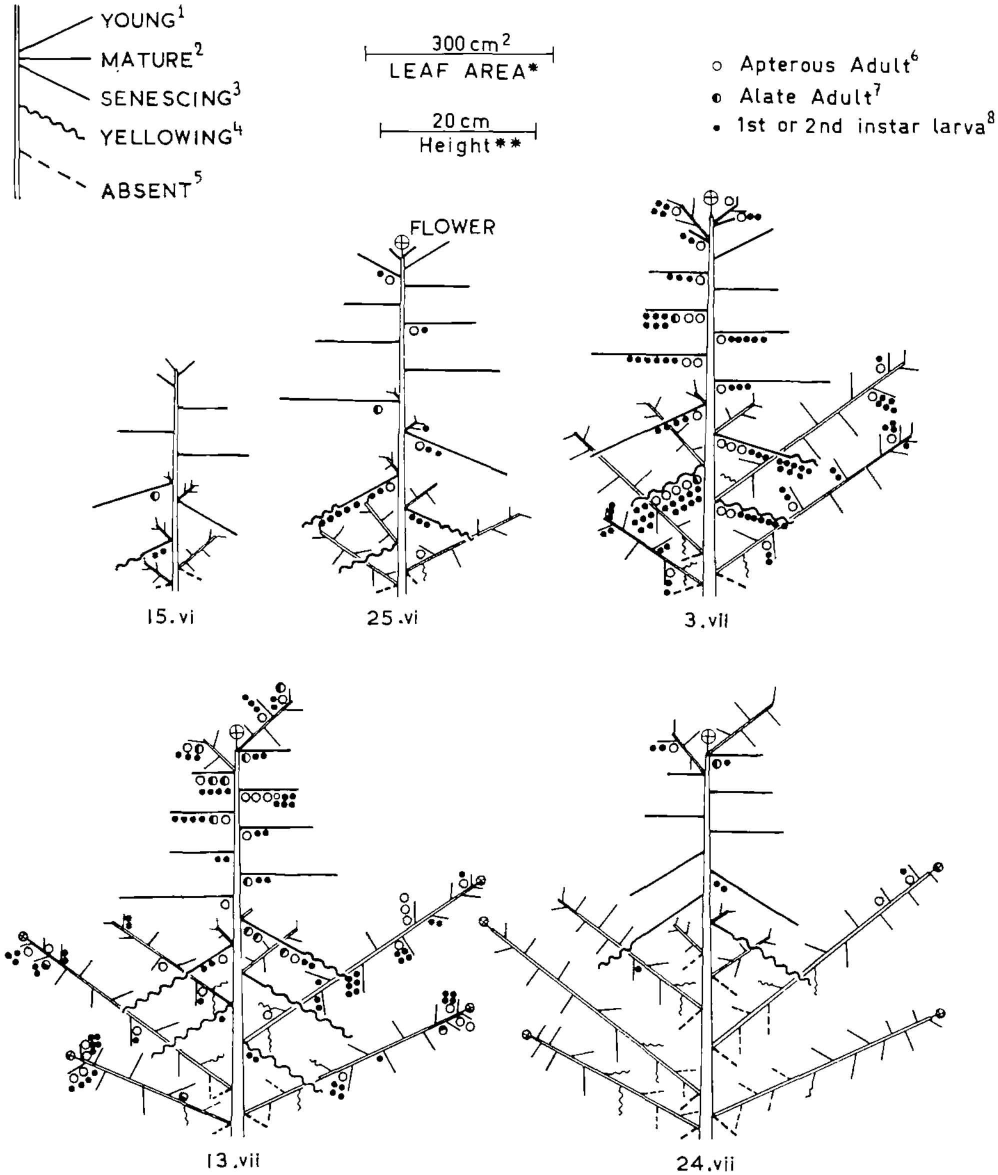
Hence, larvae of all the three aphid species were found in greatest numbers on the lowermost leaves. It has been suggested that alatae (and other forms of aphids) may congregate on the lower leaves, especially during the spring, to avoid disturbance by wind or rain (SMITH, 1919; NORRIS and BALD, 1943), or as a result of temperature or humidity gradients (FIDLER, 1949; HANSEN, 1941). JOHNSON's (1958) experiments with alate *A. fabae* were conducted in the laboratory where these meteorological variations were at a minimum, and his observations together with those made on *A. nasturtii* in the field, suggest that the movement of aphids to the lower leaves is a locomotor response related to physical or physiological patterns encountered in the plant.

POPULATION INCREASE ON THE VARIETY KING EDWARD

In 1952, at the time of the initial colonisation by alate *M. persicae*, plants of all varieties were small and most were without axillary shoots. The mean total leaf area of the variety *King Edward* on which aphid counts were made was 173 cm^2, but two weeks later the leaf area of the main stem had increased to 1324 cm^2 and that of the axillary shoots was 317 cm^2. The infestation at this time (15 June) averaged only 2,8 *M. persicae* per plant but all colonies were situated on the lower leaves. Three weeks later

FIG. 2. Progress of infestation by *Myzus persicae* in relation to the growth of the potato variety *King Edward*

The diagram represents the growth of a single plant with axillary shoots from tuber planted 24 April 1952. Adult aphids and 1st and 2nd instar larvae only included, representing the average of observations on 10 plants on each sampling date.



* *Blattfläche – superficie des feuilles.*
** *Höhe – hauteur.*
[1] *Jung – jeune.*
[2] *Reif – mûre.*
[3] *Alternd – vieillissante.*
[4] *Vergilbend – jaunissante.*
[5] *Nicht mehr anwesend – absente.*
[6] *Ungeflügelte Erwachsene – adultes aptères.*
[7] *Geflügelte Erwachsene – adultes ailées.*
[8] *Larve des 1. und 2. Entwicklungsstadiums – larve à la 1ère et 2e phase de développement.*

ABB. 2. *Fortschreiten des Befalls mit* Myzus persicae *in Verbindung mit dem Wachstum der Kartoffelsorte* King Edward

Das Diagramm zeigt das Wachstum einer einzelnen Pflanze mit achselständigen Sprossen einer am 24. April 1952 gepflanzten Knolle. Es sind nur erwachsene Blattläuse, sowie im 1. und 2. Entwicklungsstadium befindliche Larven inbegriffen, den Durchschnitt der Beobachtungen an 10 Pflanzen für jedes Zeitpunkt der Probenahme darstellend.

FIG. 2. *Progression de l'infestation de la variété* King Edward *par* Myzus persicae *en rapport avec la croissance de la plante*

Le diagramme représente la croissance d'une plante isolée avec pousses axillaires, provenant d'un tubercule planté le 24 avril 1952. Sont uniquement considérés les pucerons adultes et les larves à la 1ère et à la 2e phase de développement, et cela en valeurs moyennes pour 10 plantes observées à chaque date de prélèvement d'échantillons.

on the 4 July, there were 578 *M. persicae* per plant, with 60% of the colonies on the lower leaves of the main stem. In 1953 colonisation by spring migrants was late relative to plant growth, the first alate *M. persicae* being found on the plants on 8 June. The leaf area of the main stem was then 885 cm^2 with an axillary leaf area of 183 cm^2. As in 1952, however, the pattern of infestation was one of progressive colonisation of the plant from the lower leaves of the main stem.

This continuous re-distribution of *M. persicae* is illustrated in FIG. 2. For the sake of clarity and in order to emphasise larviposition sites, 3rd and 4th instar larvae have not been included in the diagram. From the focus of infestation on the lower leaves of the main stem, the infestation spread upwards on to the middle leaves as they passed into a senescent stage, and outwards on to the axillary shoots, where the leaves were undergoing a growth cycle similar to that of the leaves on the main stem. Despite the considerable activity of the apterous adults (DAVIES, 1932; JOYCE, 1938; DONCASTER and GREGORY, 1948) the middle (mature) leaves were rarely infested until they had passed into the senescent stage.

In 1952, aphid populations on potato plants consisted largely of *A. nasturtii*. On *King Edward* this species increased from 36 per plant on 15 June to 3128 per plant on 4 July, and 12.054 per plant on 12 July. Again, the focus of colonisation by the spring migrants was on the lower leaves and on 8 June 70% of the total colonies found were on the lower leaves of the main stem. A rapid increase in population led to almost overwhelming numbers at the peak of the infestation, about 12 July, but it was only at this time that the infestation spread to any extent on to the upper leaves of the plant. The colonies of *A. nasturtii* were, in contrast to those of *M. persicae*, relatively immobile and physiological differences due to leaf age did not seem greatly to influence the movement of the apterous adults. The infestation spread to the upper parts of the plant only because of lack of room on the lower leaves where the infestation and originated.

Few *M. euphorbiae* were found on the plants in 1952 at the beginning of the spring migration and it was not until 23 June that sufficient numbers were present to give a picture of their distribution on the plant. At this time only 34% of the colonies on the main stem were found on the young, apical leaves, although 75% of those on the axillary shoots were at the tips. This pattern of distribution remained for this species more or less throughout the growth of the plants. Again in 1953, *M. euphorbiae* was found in greatest numbers on the uppermost leaves of the plants. From larviposition sites recorded in TABLE 1 it would seem that under certain conditions, a number of colonies of *M. euphorbiae* may be established early in the growth cycle of the potato plant on the lowermost leaves, but that at a later stage the infestation is largely centred on the youngest leaves.

VARIETAL DIFFERENCES IN APHID INFESTATIONS

From observations made in 1951 it was concluded that differences in aphid populations recorded between plants of different varieties could be related to the varietal growth habits of the plants (TAYLOR, 1955, 1957). The early variety *Arran Pilot* sus-

FIG. 3. Aphid infestations on the main stem and axillary shoots of four potato varieties (1952)

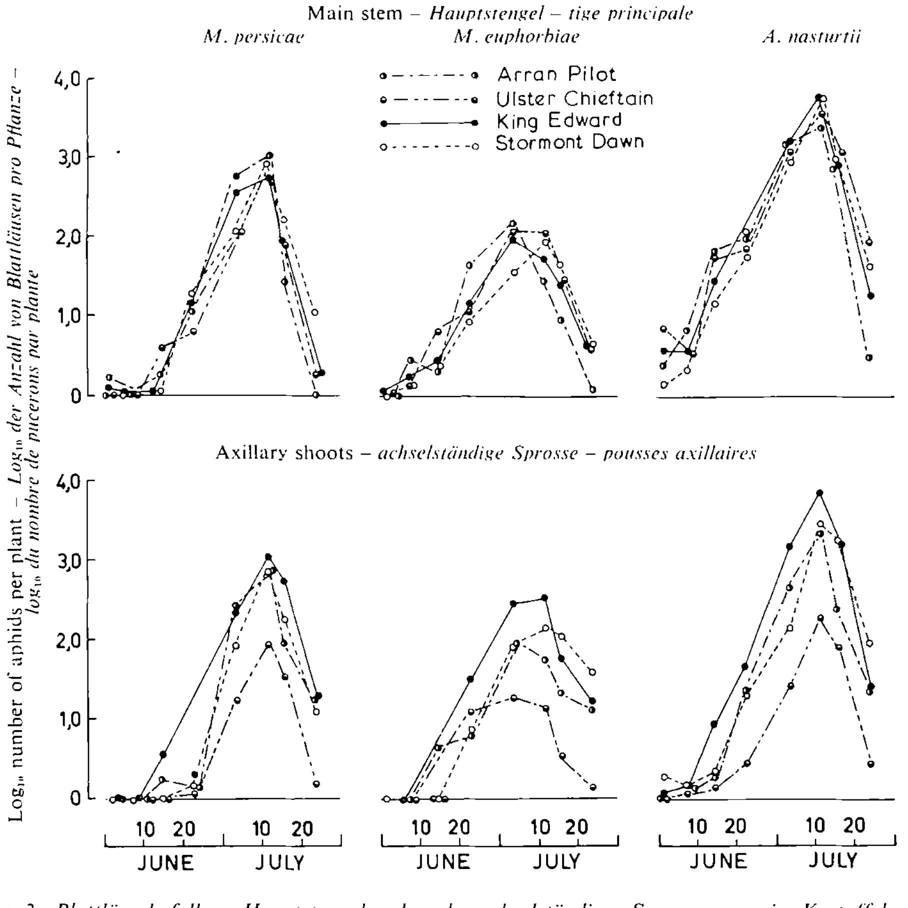


ABB. 3. *Blattläusebefall am Hauptstengel und an den achselständigen Sprossen von vier Kartoffelsorten (1952)*

FIG. 3. *Infestation de la tige principale et des pousses axillaires par les pucerons chez quatre variétés de pommes de terre (1952)*

tained the heaviest infestations of *M. persicae* because the plants were colonized by spring migrants when a large proportion of their leaves were senescing, and in a state "preferred" by *M. persicae*. With *A. nasturtii* larger maximum populations were recorded on the maincrop varieties which produced larger plants than the early varieties, and this applied also to *M. euphorbiae*. In the 1951 experiment the plants were not reduced to single main stems and it was not possible to relate aphid infestation to growth of main stems and axillary shoots. In subsequent experiments in 1952, aphid numbers were recorded separately for the different leaf types on the main stem and on the various axillary shoots. The course of the infestation was then followed for each variety in relation to the development of the leaves on the main stem and on the axillary shoots (FIG. 3).

In 1952 the spring migrants began to colonize the plants when they were still fairly small and when all varieties were growing more or less at the same rate (see TAYLOR, 1953). A period of hot weather following soon after the primary migration, together with the large population of *A. nasturtii* which built up on the plants, led to an early maturity of all potato varieties. Despite this, differences in growth habits between varieties were sufficient to influence the development of the aphid infestations.

Myzus persicae

Few migrants were found on the plants and by 23 June the total population per plant was still low on each variety. At this time the infestation was confined chiefly to the main-stem leaves and very few apterae were found on the leaves of the axillary shoots (FIGS. 2 and 3). *Arran Pilot* matured more quickly than the other varieties and by 4 July supported larger populations than any of the other varieties on both the main stem and the axillary shoots. By 12 July, when the peak of the infestation was reached, plants of all varieties bore mainly senescing leaves. Populations were significantly higher on the main stem of *Arran Pilot*, but on the axillary shoots the largest populations were recorded on *King Edward*. Expressing the peak populations as aphids per plant, *M. persicae* infestations were similar on all varieties except *Ulster Chieftain*, on which there were fewer aphids per plant due to the lack of axillary shoots.

Following the peak of the infestation, the populations of *M. persicae* on each variety declined rapidly. The rate of decline is associated with the number of winged larvae produced in the colonies and also with the leaf area on the plants which remained suitable for the apterous adults to colonise. At the height of the infestation approximately 60% of the population consisted of third and fourth instar alate larvae. By 16 July main stems of *Arran Pilot* carried fewer leaves and consequently fewer aphids than did the other varieties (FIG. 3). The maincrop varieties, *King Edward* and *Stormont Dawn*, then bore larger populations on their axillary shoots than either *Arran Pilot* or *Ulster Chieftain*, and the populations per plant were significantly greater.

Macrosiphum euphorbiae

Infestations of this species are associated with young, growing leaves at the tips of the shoots. Populations were not large in 1952 but a comparison of maximum populations supports the conclusion reached from the 1951 observations (TAYLOR, 1955) that the maincrop varieties, with their greater number of axillary shoots, supported larger populations than the early varieties with fewer axillary shoots (table 2).

TABLE 2. Maximum aphid populations on four potato varieties (1952)

	Ulster Chieftain (UC)	Arran Pilot (AP)	Stormont Dawn (SD)	King Edward (KE)	Significant difference at 5%[3]
			Myzus persicae		
Main stem[1] . . .	523	906	651	540	AP > UC, SD, KE
Axillaries[2]	91	745	726	1043	KE > AP, SD > UC
Total	614	1651	1377	1583	KE, SD, AP > UC
			Macrosiphum euphorbiae		
Main stem[1] . . .	116	106	87	53	UC, AP > KE
Axillaries[2]	19	89	189	337	KE, SD > UC, AP
Total	135	195	276	390	KE, SD > UC, AP
			Aphis nasturtii		
Main stem[1] . . .	3861	2452	5589	5189	KE, SD > UC, AP
Axillaries[2]	250	2245	4269	6865	KE, SD > AP > UC
Total	4111	4697	9858	12054	KE, SD > UC, AP

[1] *Hauptstengel – tige principale.*
[2] *Achselständige Sprosse – pousses axillaires.*
[3] *Sicherheitsgrenze 5 % – seuil de signification 5 %.*

TABELLE 2. *Höchste Blattlauspopulationen auf vier Kartoffelsorten (1952)*
TABLEAU 2. *Populations maximales de pucerons sur quatre variétés de pommes de terre (1952)*

Aphis nasturtii

A large number of spring migrants colonised the plants between 2 and 24 June and colonies which subsequently developed on the plants were fairly evenly distributed horizontally throughout the experimental area irrespective of the variety. At the peak of the infestation on all varieties except *Ulster Chieftain*, the population on each plant was about equally distributed between main stem and axillary shoots. The maincrop varieties, *King Edward* and *Stormont Dawn*, supported significantly larger populations per plant than *Ulster Chieftain* or *Arran Pilot*. Adult apterae of *A. nasturtii* seem little influenced by the physiological state of the leaf and move only when the population on a particular leaf becomes overcrowded or when the leaf wilts. Hence plants with large haulms such as the maincrop varieties provide greater scope for the expansion of *A. nasturtii* populations than the smaller early varieties. The density of infestation, expressed as aphids per unit leaf area, was similar for each variety on both main stem and axillary leaves, supporting the view that population expansion is directly related to leaf area and in agreement with ITO's (1952) expression of saturation or equilibrium population density.

DISCUSSION

The present observations and those in previous papers (TAYLOR, 1955, 1957) indicate that aphid infestations on the potato plant develop in relation to the influence of certain "plant factors" on aphid behaviour. Without having to identify or discriminate between the factors involved it may be stated that the distribution of *M. persicae* and *M. euphorbiae* is "zoned" according to the pattern of leaf production.

The upward spread of *M. persicae* infestation from the foci of colonisation on the lower leaves is related to the rate at which the leaves on the main stem and axillary shoots mature and senesce (TABLE 1, FIG. 2). It is difficult to decide from morphological characters when a leaf on an actively growing plant has changed from the mature to the senescent state and in the present study a change in leaf colour from darker to lighter green was the most useful indication of this physiological change, although obviously subject to some error. However, when mature leaves are injured mechanically or subject to sudden drought conditions they quickly and obviously become senescent. When this occurs there is frequently a rapid multiplication of *M. persicae* on these leaves and this, of course, supports the contention that there is a direct relation between colonisation by *M. persicae* and physiological leaf age.

M. euphorbiae infestations are usually associated with young, growing leaves at the tips of the shoots although the lowermost leaves are also colonised occasionally. It has been suggested that the adult aphids seek shelter on the basal leaves from adverse weather conditions such as heavy rainstorms or excessive heat (NORRIS and BALD, 1943; BRADLEY, 1952). Weather conditions in 1952 seemed favourable for aphid infestations, particularly during the early stages of growth of the plants and here again colonisation of the basal leaves is probably a manifestation of selection of leaves in a particular physiological state on the part of adult *M. euphorbiae*.

To account for similar leaf-age effects observed with *A. fabae*, KENNEDY *et al.* (1950) put forward the hypotheses that the aphids benefit from the highly nutritive organic compounds which are present in greater quantity in young and senescent leaves than in mature leaves. MITTLER (1957, 1958) found that the willow aphid, *Tuberolachnus salignus* GMEL., developed more slowly and produced more alatae on mature leaves containing relatively little amino-nitrogen, compared with a greater rate of development and fewer alatae on actively growing leaves with a high nitrogen content of the sap. It seems likely that the distribution of *M. persicae* and *M. euphorbiae* on the potato plant is also governed by stimuli associated with the nitrogen nutrients in the plant sap. On the other hand no such selection is apparent with *A. nasturtii* which possibly indicates that the potato is more suited as a host for this species, whereas *M. persicae* and *M. euphorbiae* have developed the ability to feed on the potato but only to an extent limited by its physiological condition.

Differences in aphid populations between potato varieties may be related to the growth of the plants rather than to intrinsic differences in palatibility. With *A. nasturtii* susceptibility to infestation is directly related to leaf area and varieties with large haulms bear larger populations than varieties with smaller haulms. Colonisation by

M. persicae and *M. euphorbiae* is governed mainly by the physiological condition of the host, but since *M. euphorbiae* usually colonises the tips of the shoots maincrop varieties producing many axillary shoots become more heavily infested than early varieties with fewer axillary shoots. *M. persicae* infestations are related to leaf senescence and although a variety such as *Arran Pilot*, which completes its growth cycle rapidly, will invariably be more suited for colonisation and multiplication of *M. persicae* under normal circumstances, conditions producing rapid senescence of the foliage in other varieties may also render them equally suitable as hosts. Hence differences between varieties in respect of infestation by *M. persicae* may not always be apparent or may vary from year to year, whereas *A. nasturtii* and *M. euphorbiae* infestations may always be related to varietal growth characteristics.

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SUMMARY

The distribution and multiplication of aphids on the potato plant is related to the growth of the plants. *Myzus persicae* SULZ. prefers senescent leaves and the biggest populations are usually found on the early potato varieties which develop such leaves first.

Macrosiphum euphorbiae THOS. infests the tips of the shoots and hence maincrop varieties with many axillary shoots bear bigger populations than early varieties with fewer axillary shoots.

Populations of *Aphis nasturtii* KLTB. are directly related to leaf area and varieties with large haulms are more heavily infested than varieties with smaller haulms.

ZUSAMMENFASSUNG

DIE POPULATIONSDYNAMIK VON BLATTLÄUSEN AUF DER KARTOFFELPFLANZE MIT BESONDERER RÜCKSICHT AUF DIE ANFÄLLIGKEIT GEWISSER SORTEN

Die Stärke der Besiedlung der Kartoffelpflanzungen durch migrierende Blattläuse hängt in erster Linie vom Gelingen der Frühjahrsmigration der Überwinterungsorten ab. Das weitere Verhalten der Läuse und ihrer Nachkommenschaft auf den Kartoffelpflanzen wird jedoch durch physiologische Einflüsse seitens der Wirtspflanzen bestimmt.

Der Schwerpunkt der anfänglichen Besiedlung durch geflügelte Pfirsichblattläuse (*Myzus persicae* SULZ.) liegt immer auf den untern Blättern des Hauptstengels (TABELLE 1). Von hier aus erfolgt normalerweise die Infektion aufwärts zu den mittleren, alternden Blättern und auswärts zu den achselständigen Sprossen (ABB. 2), wo die Blätter die gleiche Entwicklung durchlaufen wie am Hauptstengel. Bedingt durch die Bevorzugung der alternden Blätter durch diese Blattlausart bilden sich auf der Frühsorte *Arran Pilot* im Vergleich zu den andern untersuchten Sorten stärkere Populationen, da bei dieser Sorte alternde Blätter zuerst vorhanden sind. Dies war sehr deutlich im Jahre 1951 (TAYLOR, 1955); im Jahre 1952, als die meisten Sorten infolge der Trockenheit bald nach der Frühjahrsmigration der Blattläuse vorzeitig abreiften, war der Höchstbefall durch *Myzus persicae* bei der Sorte *Arran Pilot* nur an den Hauptstengeln gesichert schwerer als bei den übrigen Sorten (ABB. 3, TABELLE 2). Wird der Blattlausbefall pro Pflanze zum Ausdruck gebracht, das heisst sowohl auf den Hauptstengeln wie auf den achselständigen Sprossen

zusammen, so ist dieser auf *Arran Pilot* ähnlich, wie auf den meisten anderen Sorten.

Die Infektion durch *Macrosiphum euphorbiae* THOS. erfolgt auf den jungen, wachsenden Blättern an der Spitze der Triebe. Auf den spät reifenden Sorten *King Edward* und *Stormont Dawn*, die eine grössere Zahl von Seitensprossen aufweisen, entwickelten sich grössere Populationen als auf den Frühsorten *Arran Pilot* und *Ulster Chieftain* (ABB. 3, TABELLE 2).

Ungeflügelte Tiere von *Aphis nasturtii* KLTB. zeigen keinerlei Bevorzugung eines bestimmten Blatttyps und besiedeln Blätter aller Wachstumsphasen. Sofern die Bedingungen für die Entwicklung von grossen Populationen dieser Art günstig sind, wie dies 1952 der Fall war (ABB. 1), ist die vorhandene Blattfläche der begrenzende Faktor. Die spät reifenden Sorten *King Edward* und *Stormont Dawn* bilden eine grössere Zahl von Blättern als die Frühsorten und bieten demnach mehr Möglichkeit für das Entstehen von grösseren Populationen von *Aphis nasturtii* (ABB. 3, TABELLE 2).

Unterschiede in den Blattlauspopulationen verschiedener Kartoffelsorten sind eher durch das Pflanzenwachstum bedingt als durch innere geschmackliche Unterschiede. Sorten mit grossem Blattwerk bieten grösseren Populationen von *Aphis nasturtii* Platz als solche mit kleinerem Blattwerk. *M. euphorbiae* besiedelt in der Regel die Spitzen der Triebe und da die spät reifenden Sorten viele achselständige Sprosse bilden, werden sie stärker infiziert als Frühsorten mit wenig Seitensprossen. Die Stärke des Befalls durch *Myzus persicae* steht im Zusammenhang mit dem Alter der Blätter. Sorten wie *Arran Pilot*, die ihr Wachstum rasch abschliessen, sind deshalb unter normalen Bedingungen immer besser für die Besiedlung durch *Myzus persicae* und deren Vermehrung geeignet. Bei Bedingungen, unter welchen die Reife der andern Sorten beschleunigt wird, wird auch die Eignung dieser Sorten für Wirtspflanze gefördert.

RÉSUMÉ

LE DYNAMISME DES POPULATIONS DE PUCERONS SUR LA PLANTE DE POMME DE TERRE, CONSIDÉRÉ PAR RAPPORT A LA SUSCEPTIBILITÉ DE CERTAINES VARIÉTÉS A L'INFESTATION

Le degré de colonisation des cultures de pommes de terre par les pucerons migrants dépend avant tout du succès du vol de printemps à partir des lieux d'hivernage. Mais ensuite, le comportement des pucerons migrants et de leur descendance est déterminé par des influences physiologiques de la part de la plante-hôte.

Le centre de colonisation initiale par le puceron ailé *Myzus persicae* SULZ. se trouve invariablement sur les feuilles inférieures de la tige principale (TABLEAU 1) et de là, l'infestation gagne d'ordinaire les feuilles de la partie moyenne de la tige lorsqu'elles commencent à vieillir et, vers la périphérie, les pousses axillaires (FIG. 2), où les feuilles suivent un cycle de croissance analogue à celui des feuilles de la tige principale. Par suite de cette préférence marquée qu'elles manifestent pour les feuilles vieillissantes de la plante de pomme de terre, les populations de *M. persicae* se développent plus nombreuses sur la variété précoce *Arran Pilot* que sur les autres variétés étudiées, parce que les feuilles vieillissantes sont présentées le plus tôt par cette variété. Ce fait se manifesta très nettement en 1951 (TAYLOR, 1955), mais en 1952, la sécheresse survenue après la période de première migration causant un vieillissement prématuré de la plupart des variétés de pommes de terre, seules les trés nombreuses populations de *M. persicae* sur la tige principale des plantes *Arran Pilot* furent significativement supérieures aux populations trouvées sur les autres variétés (FIG. 3, TABLEAU 2). Si l'on exprimait la densité de population en nombres de pucerons par plante, c'est-à-dire par tige principale avec pousses axillaires, les populations trouvées sur les plantes de la variété *Arran Pilot* étaient égales à celles de la plupart des autres variétés.

L'infestation par *Macrosiphum euphorbiae* THOS. s'observe sur les jeunes feuilles en développement au bout des tiges. Des populations plus importantes se développaient sur les variétés tardives *King Edward* et *Stormont Dawn*, dont les pousses axillaires étaient les plus nombreuses, que sur les variétés précoces *Arran Pilot* et *Ulster Chieftain* (FIG. 3, TABLEAU 2).

Les aptères *Aphis nasturtii* KLTB. ne manifestent pas de préférence vis-à-vis du type de feuilles et

les colonisent à n'importe quel degré de croissance. Lorsque les conditions favorisent le développement d'infestations importantes par cette espèce, comme cela se produisit en 1952 (FIG. 1), le principal facteur limitant le développement de la population est constitué par la superficie du feuillage. Les variétés tardives *King Edward* et *Stormont Dawn* produisaient un plus grand nombre de feuilles que les variétés précoces et, par conséquent, présentèrent des populations plus importantes d'*A. nasturtii* (FIG. 3, TABLEAU 2).

Les différences de densité de population des pucerons d'une variété de pommes de terre à l'autre sont peut-être dues plutôt à des différences de croissance des plantes qu'à des différences intrinsèques de goût. Les variétés à fanes fort développées hébergent de plus nombreuses populations d'*A. nasturtii* que les variétés à fanes peu développées. *M. euphorbiae* colonise généralement les extrémités des pousses axillaires, de sorte que les variétés tardives à pousses nombreuses sont plus gravement infestées que les variétés précoces, qui ont peu de pousses axillaires. L'infestation par *M. persicae* se rattache au vieillissement des feuilles et si une variété telle qu'*Arran Pilot*, dont le cycle de croissance s'accomplit rapidement, convient toujours le mieux à la colonisation par *M. persicae* et à sa multiplication dans des circonstances normales, les conditions exceptionnelles occasionnant un rapide vieillissement d'autre variétés peuvent rendre ces dernières aussi appropriées comme hôtes.

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