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UNION INTERNATIONALE POUR LA PROTECTION DES OBTENTIONS VÉGÉTALES

GENÈVE

COMITE ADMINISTRATIF ET JURIDIQUE

Quinzième session
Genève, 27 et 28 mars 1985

PROTECTION DES OBTENTIONS VEGETALES
ET MALADIES A VIRUS

Document établi par le bureau de l'Union

Le Bureau de l'Union a reçu la lettre figurant à l'annexe du présent document. En accord avec le Président du Comité, il est suggéré qu'elle soit examinée sous le point 9 ("Questions diverses") du projet d'ordre du jour.

[L'annexe suit]

ANNEXE

LETTRE, EN DATE DU 2 JANVIER 1985, DE M. A.C. CASSELLS, DEPARTEMENT DE BOTANIQUE DE L'UNIVERSITE DE CORK (IRLANDE), AU SECRETAIRE GENERAL ADJOINT

Pelargoniums 'Harlequin'

Je vous écris à propos des pelargoniums "Harlequin" après discussion avec Mme I. Schumann, de la firme Fischer KG, Hillscheid-über-Koblenz, République fédérale d'Allemagne.

J'ai produit avec un étudiant de troisième cycle, George Minas, un vaste assortiment de pelargoniums dont les fleurs sont caractérisées par des pétales à bord plus foncé que le centre. Ces pelargoniums comprennent notamment les 'Harlequins' mis dans le commerce (voir les tirés à part ci-joint*). Je crois comprendre des entretiens qui ont eu lieu à l'Office fédéral des variétés à Hanovre que des problèmes se sont posés du point de vue de leur reconnaissance aux fins de la protection des obtentions végétales.

Les Harlequins sont créés en tirant parti d'agents infectieux intéressants et, par conséquent, en anticipant sur l'utilisation de vecteurs de gènes constitués par des virus manipulés. J'appuie tout particulièrement la cause de ces derniers du point de vue de la protection des obtentions végétales, en supposant que l'UPOV devra éventuellement prévoir de nouvelles règles en faveur des plantes génétiquement 'transformées'.

Je pense qu'il est important que les producteurs de plantes 'transformées' puissent recourir à la protection des obtentions végétales, si l'on veut promouvoir le développement de la biotechnologie, tout en protégeant les producteurs et la société en général des risques éventuels. L'argument principal est, à cet égard, que ces agents ne sont pas très répandus dans la nature (en d'autres termes de façon incontrôlée). Heureusement, la source de l'agent causal de l'aspect bicolore des pétales, 'Mexicana', a été cultivée à grande échelle pendant plus de 10 ans sans que, à ma connaissance, l'agent ait été transmis accidentellement. Nous avons effectué des recherches sur ce point à l'aide de divers vecteurs, entre autres.

Une deuxième particularité de ces agents est qu'ils peuvent ressembler à des gènes instables, ou à des gènes normaux, dans la mesure où des facteurs du milieu tels que la température ont sur eux un effet prévisible. La coloration particulière est influencée par la température au cours des premiers stades de développement du bouton.

J'espère que vous répondrez positivement à ma suggestion selon laquelle les Harlequins devraient être considérés comme un précédent pour les plantes génétiquement transformées. Je serais heureux d'élucider avec vous tout point que vous voudrez soulever et je serais heureux de connaître votre avis sur la manière de faire avancer la cause de la protection des obtentions végétales.

[Les tirés à part suivent]

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* En anglais seulement.

Tel. (021) 28871

Department of Botany
University College
Cork

Professor:
A.C. Cassells, M.Sc., Ph.D.

Roinn na Luibheolaíochta
Coláiste na hOllscoile
Corcaigh

2 January 1985

Dr. Mast,
Chief Executive, UPOV,
Internationaler Verband zum Schutz von
Pflanzenzuechtungen,
34 Chemain des Colombettes,
1211 Geneva 20,
Switzerland.

Dear Dr. Mast,

Harlequin Pelargoniums

I am writing to you regarding the above after discussions with Frau I. Schumann of Pelargonien Fischer KG, Hillscheid-uber-Koblenz, West Germany.

I produced a wide range of picotee pelargoniums with my postgraduate student George Minas. These include all of those commercially released 'Harlequins' (see enclosed reprints). I understand from conversations at the Bundessortenamp in Hannover that difficulties have arisen with regard to the approval of these types for breeders' rights.

The Harlequins were produced by the exploitation of beneficial infectious agents and as such anticipate the use of genetically engineered virus gene-vectors. In this latter regard I am particularly anxious to press their case for plant breeders' rights in the understanding that UPOV may have to introduce new regulations to cover breeders' rights for genetically 'transformed' plants.

I believe it is important that breeders' rights be available to producers of 'transformed' plants to encourage the exploitation of biotechnology, while protecting growers and society in general from any possible risks. The main consideration here is that such agents are not spread naturally (i.e. in an uncontrolled fashion). Fortunately, the source of the picotee agent, 'Mexicana', has been grown extensively and widely for more than 10 years without, to my knowledge, any reports of uncontrolled spread. We have investigated this aspect extensively using various vectors etc.

A second feature of such agents is that they may resemble unstable genes, or some normal genes, in being affected predictably by environmental factors such as temperature. The picotee effect is influenced by temperature during early bud development.

I hope that you will respond positively to my suggestion that the Harlequins should be regarded as a test case for genetically transformed plants. I shall be pleased to clarify any matters you may raise and would welcome your advise as to how the case for breeders' rights might be progressed.

Happy New Year.

Yours sincerely,

A. C. Cassells

Enc.

[Reprints follow]

Scientia Horticulturae, 17 (1982) 89—96
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PELARGONIUM NET VEIN AGENT AND PELARGONIUM PETAL STREAK AS BENEFICIAL INFECTIONS OF COMMERCIAL PELARGONIUMS

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(Accepted for publication 3 August 1981)

ABSTRACT

Cassells, A.C., Minas, G. and Bailiss, K.W., 1982. Pelargonium net vein agent and pelargonium petal streak as beneficial infections of commercial pelargoniums. *Scientia Hortic.*, 17 (1982) 89—96.

Pelargonium Net Vein Agent (PNVA) and Pelargonium Petal Streak Agent (PPSA) have been shown to be graft-transmissable, singly and together, to both ivy-leaf and zonal pelargoniums. In zonal pelargoniums, PNVA symptoms are seasonal; PPSA results in petal curling in some cultivars and in most petal streaking is absent or only on the lower petal surface. PNVA symptoms were stable in the ivy-leaf cultivars studied, as were those of PPSA. There was no interaction between PPSA and PNVA, doubly-infected ivy-leaf cultivars showing both symptom types.

Symptoms induced by PNVA and PPSA were eliminated by meristem culture.

The commercial potential for the exploitation of PPSA and PNVA is discussed.

INTRODUCTION

Many commercially important pelargoniums ("geraniums") depend on abnormal pigment distribution, either in the leaves or flowers, for their commercial attractiveness (Clifford, 1970). The basis of these abnormalities is important for the micro-propagator, for beneficial infectious agents may be eliminated in meristem culture or chimeras broken down in callus culture (Cassells et al., 1980). Conversely, beneficially infected cultivars can be propagated via callus/explant culture and chimeras via meristem culture (Cassells et al., 1980).

The ivy-leaf pelargoniums ("geranium") cultivars 'Crocodile' (syn. 'Sussex Lace') (Fig. 1a) and 'Mexicana' (syn. 'Roulette') (Fig. 1b) are beneficially infected with graft-transmissible agents, pelargonium net vein agent (PNVA) and pelargonium petal streak agent (PPSA), respectively. A rhabdovirus has been detected in thin sections of ivy-leaf pelargoniums showing

chlorotic vein-clearing of the leaves (di Franco et al., 1979; Russo et al., 1979). Recently, an icosahedral virus-like particle has been detected in thin sections of 'Mexicana' mesophyll cells (G. Minas, 1980, unpublished data). The latter reports suggest that PNVA and PPSA may have similar causations.

This study was undertaken to determine the behaviour of these agents in meristem culture and to study their potential singly, and together, as beneficial infectious agents in other commercially important ivy-leaf and zonal pelargoniums. Here the term "beneficial infection" infers that these agents do not prevent the commercial exploitation of the affected cultivars.

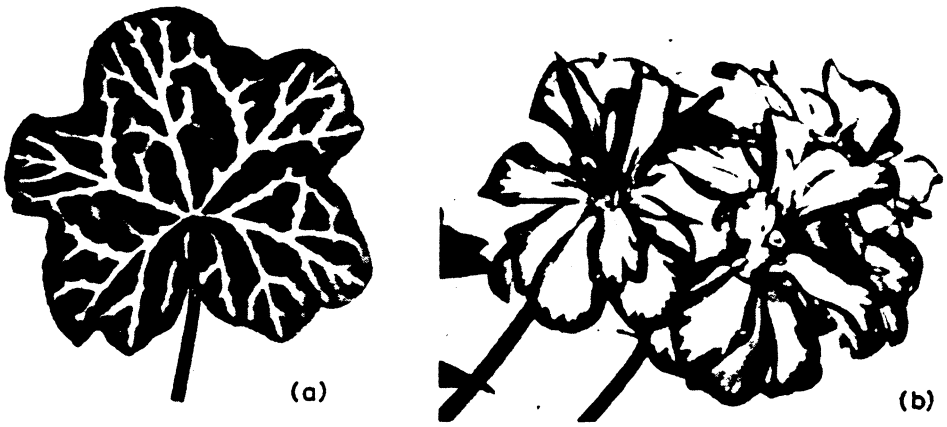

Fig. 1. (a) Leaf of 'Crocodile' showing vein clearing. (b) Flower of 'Mexicana' showing petal streak.

MATERIALS AND METHODS

Plant material. — *Pelargonium peltatum* 'Crocodile' (syn. 'Sussex Lace') and 'Mexicana' (syn. 'Roulette') were the sources of PNVA and PPSA, respectively. The following cultivars were used for graft transmission and other tests:

Pelargonium × *hortorum* (zonal "geraniums") 'Brook's Purple', 'Cardinal', 'Empress', 'Genie', 'Hakaart', 'Irene Red-Purple', 'Kleine Liebling', 'Layton White', 'Master Crampel', 'Maxim Kovalevski', 'Orange Flyn', 'Orange Ricard', 'Paul Crampel', 'Penny', 'Prince of Denmark', 'Pygmalion', 'Skelly's Pride', 'Sophie Koniger'.

Pelargonium peltatum (ivy-leaf "geraniums") 'Abel Carriere', 'Ailsa Garland', 'Fin d'Amour', 'Fire Bird', 'Galilee', 'La France', 'Mexican Beauty', 'Mrs. Warligton', 'Old Lady', 'Rigi', 'Super Rose', 'Yale'.

P. × *hortorum* × *P. peltatum* (semi-ivy-leaf "geranium") 'Kewense', 'Schöne Grentchen'.

Plant cultivation — Plants were grown throughout the year in a glasshouse

with a minimum temperature of 15°C in Irish Peat Moss supplemented with Bio P Base fertilizer (Pan Britannica Industries, Herts, U.K.). Flowering was stimulated out-of-season by placing the plants in 10°C-chambers in the glasshouse with a 16-h photoperiod provided by fluorescent lamps.

Meristem culture. — Shoot tips were excised and the apical domes cultured on the medium of Hamdorf (1976), with slight modification as described previously (Cassells et al., 1980) (see Table I).

Adventitious shoots (approximately 2 cm in height) from these cultures were placed on rooting medium (Cassells et al., 1980) (see Table I) and following root formation, plantlets were established on heated benches (15°C) and transferred to insect-proof cages, as appropriate, for virus testing.

TABLE I

Tissue culture media used for meristem proliferation and rooting of progeny shoots; pH adjusted to 5.8

Constituents	mg/l	g/l
Meristem medium		
MS[1] basal medium without growth substances		4.71
Ammonium nitrate		0.825
Sodium dihydrogen phosphate		0.15
Casein hydrolysate		1.0
Sucrose		30.0
Indoleacetic acid	2.0	
Gibberellic acid (GA_3)	1.0	
Kinetin	4.0	
Adenine sulphate	50.0	
Meso-inositol	100.0	
Agar		6.0
Rooting-medium		
MS basal medium without growth substances		2.36
Sucrose		15.0
Kinetin	0.01	
Indoleacetic acid	0.1	
Agar		6.0

[1] Murashige and Skoog (1962).

Disease transmission and testing. — Geranium shoots with PPSA or PNVA symptoms, or symptomless plants from tissue culture, as appropriate, were used as scions. The stocks were symptomless rooted cuttings of the cultivars listed above (see text also) or symptomless *P* × *hortorum* seedlings.

A clean oblique downward cut was made in the stem of the stock and the detached scion inserted so that the cambial regions were aligned as

completely as possible. The graft was bound with self-adhesive rubber tape (Stericrepe;Beacon and Janis Ltd., London). Two leaves were left on the scion and half of the leaves of the stock were removed, along with the apical bud, to stimulate the growth of axillary buds. Grafted plants were placed in a mist propagator for 4—6 weeks and when a good graft union was established they were returned to normal glasshouse conditions. Plants were observed for up to 18 months for symptoms.

RESULTS

The initial graft transmission studies were between 'Crocodile' which has a pale rose-pink flower (PNVA-infected) and 12 other ivy-leaf cultivars. There were 10 replicates in all cases, which were almost all successful and resulted in positive transmissions. In some cases, not confined to specific cultivars, serious leaf distortion was observed in the first-formed new leaves on the stock. However, foliar symptoms stabilized in all cultivars and resembled those of 'Crocodile'.

In a further series of graft-transmission studies (10 replicates of each as above) 'Crocodile' (PNVA) was grafted to 18 zonal geraniums and 2 zonal—ivy-leaf hybrids. In almost all cases, graft transmission was observed. The net vein symptoms first appeared in the newly formed leaves on the stock adjacent to the scion and were severe and greatly reduced leaf area (Fig. 2). Then, depending on the growth of the stock, the symptoms tended to be less pronounced or to disappear. Symptoms tended to reappear in early spring and late summer.

Fig. 2. Graft transmission of PNVA from 'Crocodile' to zonal 'Paul Crampel'. Net vein symptoms in the young leaves above the graft union.

Fig. 3. Symptoms of PPSA in zonal 'Paul Crampel'.

PPSA was successfully graft-transmitted from 'Mexicana' to 12 ivy-leaf cultivars and to 2 ivy-leaf × zonal hybrids. In all cases, petal streak symptoms of the same appearance as those in 'Mexicana' were observed. In some single-flower cultivars, curling of the petals was observed.

Graft-transmission of PPSA to zonal geraniums resulted in serious petal curling and distortion in most cultivars. In others, the symptoms were less pronounced, or absent from the face of the petal but appeared as clearing of pigment from the petal veins when viewed from the back (Fig. 3). The symptoms produced in the zonal ivy-leaf hybrid 'Schöne Grentchen' (vein clearing on both petal surfaces) were the most attractive in this series of transmissions.

In the final studies on graft-transmission, PNVA and PPSA were the subject of double graft transmission to a series of ivy-leaf cultivars. The results show that double transmission was achieved in all cases and there was no apparent interaction between PPSA and PNVA in the doubly infected plants.

Meristem culture is now an established commercial procedure for the propagation of commercial pelargoniums. PNVA has previously been shown to be eliminated in meristem culture of 'Crocodile' (Cassells et al., 1980). Shoot-tip cultures were set up here to determine whether PPSA and PNVA were transmissible. Meristem culture of 'Crocodile' was repeated. The data (Table II) show that progeny plants derived via meristem culture from both PPSA- and PNVA-infected cultivars were symptomless from observations over 12 months in the glasshouse. Furthermore, PNVA or PPSA symptoms were not produced in symptomless 'Paul Crampel' seedlings to which the meristem cultured plants were grafted.

TABLE II

Propagation of plants from shoot tips of PPSA or PNVA affected geranium cultivars

Geranium cultivar	Affected by	No. of cultured meristems	No. of established meristems	No. of adventitious shoots in 8 months since cultures were started	No. of plants potted	No. of plants affected, observation of leaves and flowers for 1-year growing-period
Paul Crampel	PPSA	100	15	93	21	0
Mexicana	PPSA	120	12	95	36	0
Rigi	PPSA	80	7	75	21	0
La France	PPSA	80	15	92	31	0
Crocodile	PNVA	120	18	123	48	0
Rigi	PNVA	80	6	64	22	0
La France	PNVA	80	5	71	18	0

DISCUSSION

As a preface to this discussion, it is important to mention that in the course of these studies over 3 years, neither PNVA or PPSA were observed to spread naturally in the glasshouse or field. Indeed, many attempts to sap-transmit, or to achieve vector transmission, were unsuccessful (K.W. Bailiss, G. Minas and A.C. Cassells, 1980, unpublished data). Consequently, there appears to be little risk of uncontrolled spread of these agents, possibly both viral, within the commercial nursery.

Both PNVA and PPSA are readily graft-transmissible to all ivy-leaf and zonal cultivars tested. Neither, however, produce attractive, or in the case of PNVA, stable symptoms in zonal cultivars. Consequently, they have little commercial potential in zonal cultivars.

Both PNVA and PPSA, singly or together, have considerable commercial potential in ivy-leaf cultivars. PNVA transforms ivy-leaf geraniums into fancy leaf cultivars, which may encourage earlier purchase, i.e. as foliage rather than flowering plants. Furthermore, while 'Crocodile', the source of PNVA has a relatively pale flower, the presence of PNVA in e.g. 'Abel Carriere', which has a strong flower colour (orchid purple), makes an attractive plant (Fig. 4a). The potential for PPSA-transformed cultivars may be less than for those altered by PNVA, because much of the attraction of PPSA-affected flowers lies in the contrast between the pigment and white (pale) area on the petal. Where the petal pigment is originally pale, this effect is reduced. However, with strong flower colours, e.g. 'Yale' which has a red flower, the effect is attractive (see Fig. 4b).

The combination of PPSA and PNVA in doubly infected cultivars results in the production of a third series of beneficially infected cultivars. Those with a strong flower colour-contrast also have commercial potential (Fig. 4c). 'Crocodile' and 'Mexicana', sources of PNVA and PPSA, respectively, are

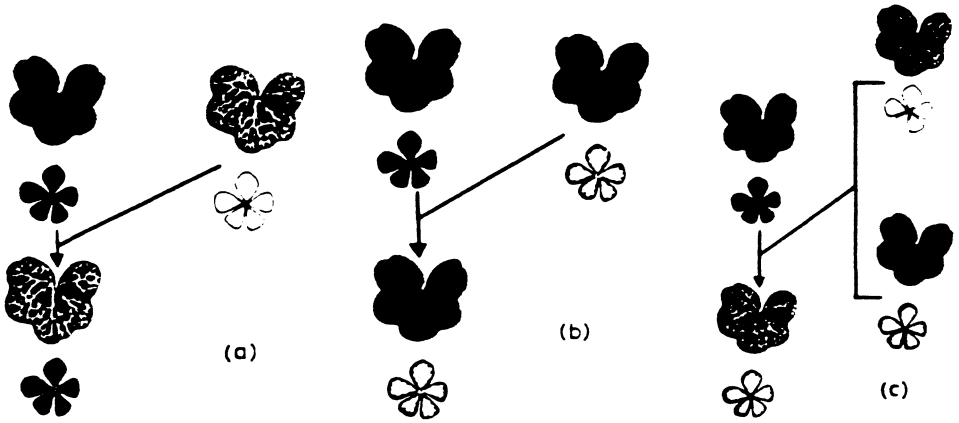

Fig. 4. (a) Schematic representation of the transfer of PNVA from 'Crocodile' which has a pale flower to a cultivar with a strong flower colour to produce a "new" cultivar. (b) Schematic representation of the transfer of PPSA from 'Mexicana' to another cultivar, e.g. 'Abel Carriere', with a strong flower colour, to produce a "new" cultivar. (c) Schematic representation of the transfer of both PNVA and PPSA to another cultivar to produce a "new" doubly-infected cultivar.

only two of many pelargonium cultivars with abnormal pigmentation. There are numerous similar examples of abnormal pigmentation induced by beneficial infections affecting other ornamental crops, e.g. abutilon and tulip (Gibbs and Harrison, 1976).

Our studies emphasize the problems facing the micro-propagator who introduces meristem culture for such cultivars, and poses the problem of whether such beneficial infections can or should be exploited commercially where there is the possibility of disease spread.

The results presented here pose a dilemma for the commercial pelargonium propagator who uses meristem culture, or is proposing to introduce it, for meristem culture apparently cannot be used to propagate these beneficially infected cultivars. Either the micro-propagator must use explant culture (Cassells et al., 1980) or re-inoculate the plants with the beneficial agent(s). Explant culture may not be efficient in that, for example, regeneration may be limited (Cassells, 1979). The causal agent(s) of PNVA and PPSA have not been isolated, purified and fully characterized, thus re-inoculation is a problem.

Stone and Hollings (1973) isolated a flower-break virus (PFBV) from *P* × *hortorum* 'Irene' and 'Paul Crampel'. Unlike PPSA reported here, PFBV induced flower colour break in these cultivars throughout the year. More recently, di Franco et al. (1979) and Russo et al. (1979) identified a vein-clearing virus in *P. peltatum* (PVCV) resembling PNVA described in this work. However, the symptoms of PVCV, shown to be a sap-transmissible rhabdovirus, appear to differ from those of PNVA. The present authors have failed to detect rhabdovirus-like particles in the cells of PNVA-affected

pelargoniums, nor have they been able to sap-transmit PNVA. Further studies are required to elucidate the relationship of PNVA and PPSA to PVCV and PFBV, respectively.

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THE GARDEN

Vol 108 Part 4
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Journal of The Royal Horticultural Society

Wyes new geraniums

Anthony Hamilton *describes some new developments with an old favourite.*

If one looks at the history of the development of any popular flower certain trends are continually repeated. The most obvious is the alteration of a single flower into a double and thence on to a full multi-petal. It seems that there is some strange need for Man to turn all his flowers into coloured mops.

Another tendency is to try and produce colours in a flower which are usually quite alien to its wild ancestors. Debatably one of the most attractive aims is to produce flowers with picotee colouring. In other words where the colour is confined just to the edge of the petals while the rest of the flower is white or, at most, a very pale contrasting colour.

Dianthus (pinks and carnations) is probably the genus best known for picotee flowers but this type of colour distribution occurs from time to time in most garden genera which are under active development and hybridisation.

One genus which has not so far produced a satisfactory range of picotees is *Pelargonium*. A few may be found in the Regals (*P. cucullatum*) and the nearest in the Zonals is the exquisite 'Apple-Blossom Rosebud'. This variety combines a full multipetal flower which is hopelessly impractical in England's climates where rain lingers for so long that botrytis soon appears. It is nevertheless excellent under cover.

The ivy-leaved "geranium" (*Pelargonium peltatum*) is not known for its picotees and when the first one appeared, the garish red and white 'Rouletta', it caused a sensation.

The history of the introduction of this variety is now more or less unearthed. A gaudy purple-red variety called 'Mexican Beauty' produced a sport, allegedly in Mexico, a decade ago. From there it was only a short hop to the large geranium growers in California and it was William E. Schmidt who acquired the first stock.

'Rouletta's' introduction into Europe was *via* the firm Topperwein's in Bavaria who received it from Schmidt, and it very quickly appeared at Fischer-Pelargonien, the world's largest growers. Henry Weller of the British and European Geranium Society introduced it into England in 1975 and the first commercial grower to whom he passed it on was Dennis Magson of Hall's Court Nursery.

Wherever it was introduced the effect on the general public was electric – a real "sale-on-sight" item if ever there was one. It is usually a sign of a flower's popularity that, even in a very short time, it acquires many names.

'Rouletta' seems set to produce a record for, in barely five years, it has spawned another five names! In Germany it is "Mexicanerin" which, because that proved something of a mouthful, the English changed to "Mexicana". In North America it is also known as "Bayview Peppermint" and "Peppermint Candy": an allusion to the red and white colouring of US peppermints, unlike our green ones! Perhaps the Dutch got it about right when, after surveying the whole confusing scene, they simply renamed it "Cocktail"!

But to return to the plants origins. While stock of 'Rouletta' was growing at Hall's Court Nursery, Dr (now Professor) Alan Cassells who was working at the time at nearby Wye College saw 'Rouletta' and immediately speculated about its origins.

It was an unusual mutation and it crossed Dr Cassells' mind that it might be of viral origin. Of course, any thought of a plant contaminated with a virus automatically produces plenty of reactions of the "Shock! Horror!" type from all good gardeners. But what these same gardeners do not realize is that several well known garden plants owe their striking coloration to a viral infection.

Reputedly the oldest known records of a virused flower are the still life paintings of the Dutch School where the striking Rembrandt series of tulips are constantly featured. The bulbs can still be purchased today but they no longer fetch the "King's

The first picotee ivy leaved geranium to appear was the garish 'Rouletta'.

Two of the first six commercial Harlequins which were developed at Wye: *above*, 'Picotee'; *right*, 'Mahogany'.

ransom" which they did in the seventeenth century when Tulipomania was at its height. (For the technically minded the causative agent is referred to as tulip-breaking virus).

Aesthetic variegation in the leaves of some plants is also caused by viruses and the best known is that old favourite of parks departments and town halls, namely *Abutilon striatum* var. *thompsonii* (technically abutilon variegation disease).

In both these cases it is common knowledge that these viruses do not spread (in our climate) as do the pathological types, if only from the facts that all the nation's tulips (and all the wild ones for that matter) have not turned into Rembrandt types; nor do all members of the mallow family in our gardens and hedgerows have variegated leaves.

Dr Cassells resolved to investigate this new colour-break geranium and took plants back to Wye College to see if there was something in "Mexicana", as it had now become in England. If his theories were correct then whatever was causing the striking coloration might be graft-transmissable.

An extensive programme which involved grafting scions of "Mexicana" ('Rouletta') onto a large range of ivy-leaved and other geraniums was started by his then research student (now Doctor) George Minas. Particularly chosen as stock plants were those with strong clear colours so that the picotee which might result would contrast dramatically with the white of the rest of the flowers. All the graft combinations produced a change in the flowers of the stock plants. Many were considered commercially highly desirable but all of zonal origin were unattractive. Dr Cassells taught Mr Magson the grafting technique and started giving him the successful progeny which had been created together with their parental combination.

Shortly after this Dr Cassells was appointed to the Chair of Botany at University College, Cork, and a decision had to be made about the future of the plants that he and his team had produced. It was felt that, since Mr Magson had introduced Wye College to "Mexicana", and provided the other stock plants, the balance of the progeny should also be passed to him and this was duly done in 1979.

Fully alive to their potential, Mr Magson replicated some of the grafts to build up stock and multiplied them by conventional means as fast as he reasonably could. He also named them, including choosing the excellent series name of Harlequins.

Mr Magson has continued the work started by Professor Cassells and his team, and has worked on virtually every ivy geranium that can be found. Some of these later grafts have commercial potential but they are not among the first six varieties to be released to the gardening market this spring, all of which were originally created at Wye.

The first six commercial Harlequins are:– 'Alpine Glow', 'Mahogany', 'My Love', 'Picotee', 'Pretty Girl', 'Rosie O'Day'.

In the meantime the causal agent has remained a mystery. It really doesn't matter whether it is a virus or not because in the six years that it has been grown seemingly by every geranium enthusiast in the world, no other plant has become infected, if that is the correct term.

Indeed every effort has been made to transfer the agent by an easier method than grafting. The usual range of sap-sucking insects have been tried; sap from "Mexicana" has been poured over damaged leaves or injected into stems but still no transfer by these fairly standard virus methods has been achieved. Almost as an act of desperation, the parasitic plant dodder (*Cuscuta*) has been used but still to no effect.

So with no success at easy transfer, the next aim was to identify the factor which was causing these floral mutations.

Mr Magson contacted ADAS (Agricultural Development and Advisory Service) at Canterbury and sought their help. David Beddall, the Horticultural Advisory Officer, took on the task of using ADAS's nationwide facilities and, in this context, especially their virus unit with its electron microscope at Cambridge. No virus was found.

So, for the moment, the causal agent remains a mystery, doubtless to be solved by an academic in later years. However, this remains a most interesting discovery; indeed, almost a disease turned round and tamed for the benefit of Man's pleasure!

These Harlequins are being distributed world wide and patents are being taken out in some countries and for that reason alone the parental combinations cannot be divulged yet. In several countries there is one exclusive licensee and overseas readers who may wish to find their local supplier should write to the address at the end of this article.

In England the Harlequins are being sold by mail order from Unwins Seeds Ltd., Histon, Cambridge CB4 4LE. Queries from *overseas readers only please* to:– A. P. Hamilton, Grimsdyke House, 12 Southcourt Avenue, Bexhill-on-Sea TN39 3AR, East Sussex.

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