SOME ASPECTS OF THE 'JUNO GROUP' OF IRISES

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Abstract - The Juno group of *Iris* (Mathew, 1981) have been treated taxonomically as a section (sect. Juno), as a subgenus (subg. *Scorpiris*) and as a separate genus (*Juno*). Whatever its status, the group, comprising some 57 species, is a morphologically convincing assemblage, occurring in the Mediterranean region eastwards into western and central Asia. The distribution, habitat and characteristics of the group are described.

Key words - *Iridaceae*, *Iris*, *Juno*, taxonomy

Introduction

The large region encompassing the Mediterranean, South-west Asia and Central Asia is primarily a region of winter precipitation followed by a short spring growing season and then summer heat and drought. There are a few exceptions, for example in the Black Sea and Caspian Sea regions and in some of the higher altitude areas where rainfall may occur at times during the summer. The whole region is particularly rich in *Iris* species, with over 150 species recorded within its boundaries. Perhaps more interesting than the overall number, which is nevertheless impressive in itself, is the diversity of the species, so diverse that they have been placed in at least 13 different infrageneric groupings; some of these are so divergent, including *Juno* (Mathew, 1981), that they have been recognised by some authorities as separate genera (Rodionenko, 1961). The groups recognised (the list is not intended to reflect a taxonomic hierarchy, but is used just for convenience), showing approximate numbers of species in the region are:

Bearded - "Pogoniris", c. 22 species; "Oncocyclus", c. 30 species; "Regelia", c. 8 species; "Hexapogon", 2 species.

Non-Bearded - "Sibericae", 1 species; "Laevigatae", 1 species; "Spuriae", 8 species; "Tenuifoliae", 3 species; "Syriacae", c. 3 species; "Unguiculares", 2 species.

Bulbous/Cormous - "Xiphium", 7 species; "Juno", c. 57 species; "Reticulata", c. 10 species, including *Alatavia* Rod. (2 species: *I. kolpakowskiana* Regel & *I. winkleri* Regel) and *Iris pamphylica* Hedge; *Hermodactylus* (Tourn.) Mill. (*I. tuberosa* L.), 1 species; *Gynandriris* Parl., c. 2 species.

A few of the above groups (*Sibiricae, Laevigatae, Spuriae*) consist of species occurring in mesophytic or even aquatic conditions and, accordingly, have not developed any exceptional morphological features to deal with the summer heat and drought. Most of the others, however, have evolved to cope with the conditions, either by the possession of tough, narrow, leaves or by the development of a swollen rootstock for storage purposes through the prolonged drought period; sometimes species exhibit both of these features. The possession of a swollen rootstock containing food/water reserves has a further benefit: it enables the plant to initiate flower buds well in advance of visible growth and then burst into growth very rapidly when conditions improve. Most of the geophytes in the region start their root growth at the onset of autumn rains and make their main above-ground growth during the short, warm, moist spring before the heat and drought of the summer months. A considerable number of geophyte species exhibit a strategy which is particularly well developed in the region - they flower in autumn at the onset of cooler, moister weather and are pollinated/fertilised at this time, then they enter a period of 'semi-dormancy' through the winter; this leaves only leaf development and maturation of the fruits to take place in spring. This strategy thus allows the maximum use of two short growing periods - the damp autumn before the onset of winter, and the warm, damp spring before the onset of the hot, dry summer. Interestingly, no *Iris* species have evolved to flower in the autumn although *Crocus* L. (also in *Iridaceae*) has many autumn-flowering species.

Discussion

Storage systems in *Iris* (and its relatives) in this region consist of either swollen rhizomes or bulbs (corms in the case of *Gynandriris*). Referring to the above list, most of the species with markedly thickened rhizomes occur in the "Bearded group" (Bearded irises, *Oncocyclus* & *Regelia*); the rhizomes of the "Non-bearded group" are much less developed in this respect, but they may have narrow, tough, drought-resistant leaves. Many species in the region (c. 80 spp.) have developed a bulbous 'rootstock' with the Juno group and to a lesser extent the Reticulata group particularly rich in species; it is the development of a bulb which has enabled these to survive in particularly adverse habitats in seasonally very dry, rocky places and semi-deserts. The Reticulata group species possess bulbs which have seasonal roots lasting only about six months and so, like so many geophytes of the region, during their summer dormancy there are no living roots attached. On the other hand, the Juno irises have living roots visible at all times of year. Before discussing the Juno group in more detail, attention should be drawn to the *Syriacae* in the non-bearded group since this has a particularly interesting rootstock structure. In the seedling stage and early years of growth they (e.g. *I. masia* Stapf., *I. grant-duffii* Bak.) develop a bulb which is almost indistinguishable from that of the Reticulata irises; at maturity they retain this bulbous stock but also develop a tough, woody rhizome. The author considers that the *Syriacae* are very closely allied to the Reticulata group, and especially to *I. pamphylica* which, although classified with the Reticulatas (i.e. subgenus *Hermodactyloides* or genus *Iridodictyum*) on the basis of its quadrangular leaves, has much in common with the *Syriacae* (Mathew, 1989) and could well be classified with them. Rodionenko (1961; 1987) has also expressed the view that 'there is reason to suppose that the ancestral form of *Iridodictyum* (*I. reticulata* M.Bieb., etc.) may have been a species close to the Asia Minor species *Iris grant-duffii*'; this observation was made at a time when the species most closely related to the *Syriacae*, *I. pamphylica*, was not available to him.

The largest group of species, the Junos, have a storage system and rootstock which is unique among the irises, and their floral morphology is also distinctive. The Juno bulb consists of few scales attached to a small 'basal plate' (a very reduced stem) which also gives rise to thick (in most species) fleshy storage roots. The whole of this 'unit' - bulb and roots - is replaced each year, but the sequence of replacement is interesting. During the summer dormancy the bulb is at its maximum size and the storage roots are well developed, but they are simple, with no lateral roots (see Fig. 1). In autumn, with falling temperatures and increasing moisture levels, growth commences in the form of lateral roots which develop towards the

Figure 1 - Bulb of a 'Juno' *Iris* (subgenus *Scorpiris*) in the summer, dormant state showing well-formed bulb and storage roots

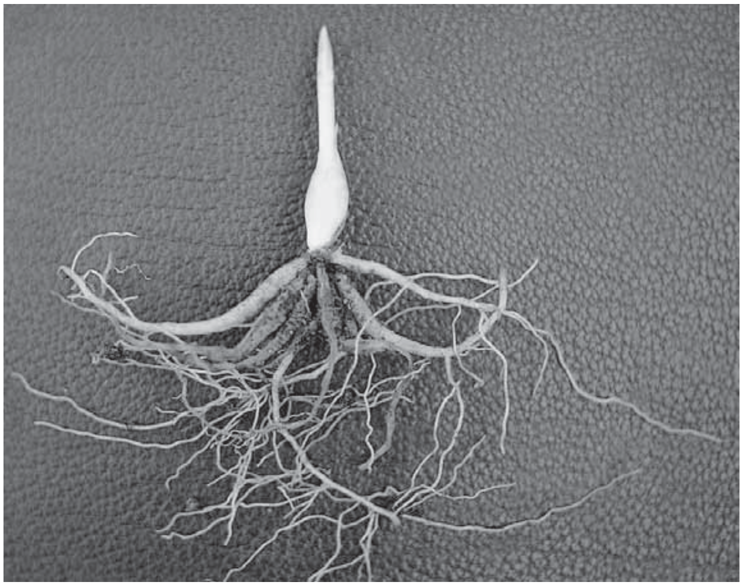

Figure 2 - Bulb of a ‘Juno’ *Iris* (subgenus *Scorpiris*) in the growing season (autumn-winter), showing feeding (secondary) roots.

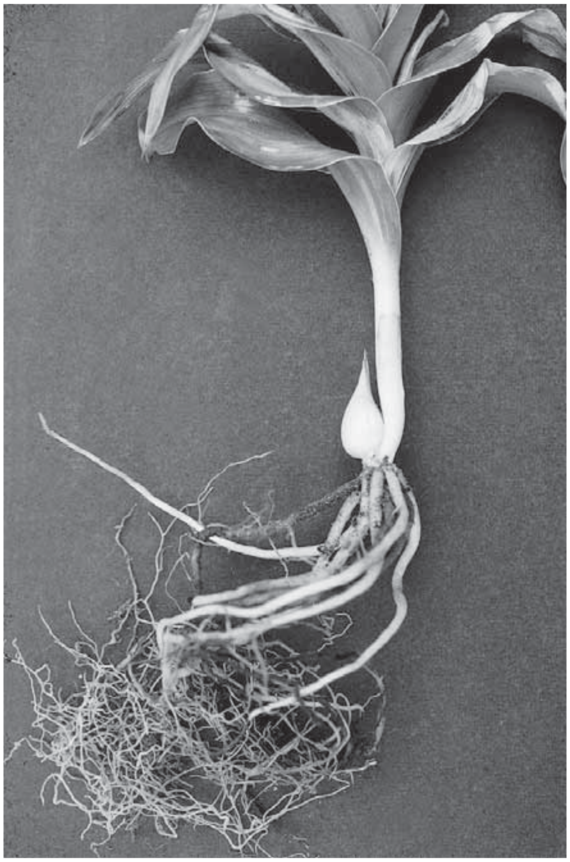

Figure 3 - Bulb of a ‘Juno’ *Iris* (subgenus *Scorpiris*) in late spring at the end of the growing season, showing the old feeding roots, new storage roots, and the aerial shoot with new bulb forming alongside.

tips of the storage roots (see Fig. 2). Over the next few months this situation continues, with an extensive system of thin feeder roots forming. At the same time the foliage develops and the plant approaches the flowering stage; this happens at the expense of the stored reserves in the bulb which starts to shrivel away, and the storage roots also diminish in thickness. Around flowering time or soon after, the feeding root system is at about its maximum development and the bulb at its minimum. At this point, the 'basal plate' begins to form new, thick, storage roots which will develop to their full size before the onset of summer heat/drought but will not produce feeder roots until the following autumn. Concurrently with this, the basal plate also produces a lateral bud which forms a new bulb alongside the [shrivelling] current season's flowering bulb (see Fig. 3). In a vigorous plant two, sometimes more, lateral buds may develop into new bulbs thus giving rise to a clump of bulbs for the coming season. The final stage before the period of rest is the production of seed, during which time the whole of the aerial portion dries off and the old flowering stem dies off, all the way down to the basal plate. In one group of species, *I. nicolai* Vved. and its relatives, there appears to be a modification of this in that the lower portion of the stem remains, thick and fleshy, after the aerial portion has died away, hence it does not die back as far as the basal plate (Rodionenko, 1961; 1987). In the case of a few species, for example *I. fosteriana* Aitch. and Bak., the storage roots are barely thickened.

All the underground parts of the Juno irises, except for a small portion of 'basal plate' are thus replaced in their entirety each year in a definite sequence. The replacement sequence of the bulb itself takes place within a set of papery tunics, so it is only possible to view this procedure if the bulb is dug up and stripped of its tunics at various stages during the growth cycle. In some of the species from low rainfall, semi-desert situations (e.g. *I. stocksii* (Bak.) Boiss. from Afghanistan/ Baluchistan), the tunics do not decay but build up over a period of years into a thick, protective coat which is often prolonged into a long 'neck' (formed also partly from the old leaf sheaths) reaching up to the soil surface and protecting the aerial shoot.

The leaves of the Juno irises (see Fig. 4) are produced in a distichous arrangement and are mostly canaliculate in section; their anatomy has been studied in some detail (Rudall and Mathew, 1993). They are bifacial, unlike the quadrangular-sectioned leaves of the Reticulatas (subgenus *Hermodactyloides* or genus *Iridodictyum*) and the 'flat' sword-like leaves of the rhizomatous irises which are unifacial. In fact the leaves of the Juno irises are thought to be unique in the *Iridaceae* (Rudall and Mathew, 1993) in that they show no evidence of a unifacial structure, even at the extreme leaf tip or in the seedling stage. Those of the *Xiphium* irises, although largely bifacial at maturity do have unifacial tips, and the seedling leaves are also unifacial. From the point of view of practical identification, the arrangement of the leaves on the flowering stem is of some value. In some species the leaves remain tightly packed together in a basal cluster (e.g. *I. persica* L. and its allies, *I. nicolai* and its allies) whereas in others the stem elongates and displays clear internodes between the leaves (e.g. *I. magnifica* Vved., *I. bucharica* M. Foster and many others). Those species in which the leaf clusters remain compact often have flowers with exceptionally long perianth tubes, with the ovaries and subsequent capsules produced near ground level.

The flowers of the Juno irises are also distinctive, mainly in view of the fact that nearly all of the c. 57 species have reduced inner perianth segments ('standards') which are held in a horizontal or deflexed position, fig. 4. In only one species are the inner segments both suberect and large (*I. cycloglossa* Wendelbo). The feature of reduced inner segments has occurred several times, both in species of other unrelated groups of *Iris* (e.g. *I. danfordiae* (Bak.) Boiss. in subgenus *Hermodactyloides* or genus *Iridodictyum*, *I. tridentata* Pursh. in series *Tripetalae*) and in other genera (e.g. several, but not closely related, species of *Moraea*) so is probably not of any fundamental importance in the classification. However, it is interesting that, in this case, almost all the species of this large group share the same characteristic. The evolutionary significance for the reduction in size of these segments is, of course, unknown, if indeed there is any at all. There are, however, some related facts which are worth commenting upon. The Juno irises flower very early in the year, at a time when there are often frequent rain showers. The Juno flower is essentially a funnel shape, formed by the angle of the three outer perianth segments ('falls') and the three petaloid style branches.

Figure 4 - *Iris vicaria*, showing distichous, caniculate leaves and the reduced, deflexed inner perianth segments, charateristics of the 'Juno' group (subgenus *Scorpiris*). Also visible is the narrow canaliculate haft of the outer perianth segments.

If the three inner segments were also broad and erect they would tend to complete the funnel, thus acting as a trap for excess water; as it is, the small, horizontal or deflexed inner segments (see Fig. 4) act as ‘gutters’, thus allowing the rain which inevitably falls into the centre of the flower to disperse and drip off at their tips. Indeed, in some species the inner segments are 3-lobed with the middle lobe longer and acuminate or aristate, thus acting as a very efficient ‘drip-tip’; this phenomenon can be seen in the case of leaves of many other plants from wet climates (e.g. *Arisaema* species from monsoon China). The author has carried out simple experiments with the flowers of some Juno species and this does actually work in practice, although whether this is the evolutionary reason for the existence of the character is unknown!

The rest of the morphology of the Juno flower is unremarkable and similar in overall structure to many other irises; however, there are two points worthy of comment from the taxonomic viewpoint. The first concerns the shape of the haft of the outer segments (falls). In some species the haft is narrow and canaliculate (as in *I. bucharica* and *I. vicaria* Vved. see Fig. 4), in others it is very widely winged (as in *I. persica* and allies, see Fig. 5) and in one group (*I. nicolai*, *I. rosenbachiana* Regel, *I. doabensis* Mathew and allied species) the margins of the haft are folded downwards (see Fig. 6). Although variable to some extent, this feature is of undoubted value at the species level and possibly in the larger grouping of species. Secondly, it can be observed that the style branches, with their bilobed ‘crests’, are often a quite prominent feature of the flower whereas the pollination

Figure 5 - *Iris persica*, showing the very wide haft of the outer perianth segments.

Figure 6 - *Iris nicolai*, showing the reflexed margins of the haft of the outer perianth segments.

tunnel is, on the other hand, poorly developed compared with that of, for example, the bearded and *Oncocyclus* irises. Unfortunately, little is known of the pollination biology of the *Juno* irises and field studies are required to gather even the most basic of information such as the identity of insect visitors. Clearly the colour and 'signal patch' markings on the outer segments are there for the purposes of attraction, and some species have strongly fragrant flowers (e.g. *I. doabensis*, with a fruity fragrance, and *I. cycloglossa* with the scent of cloves or *Dianthus*), but there are many unanswered questions. Why, for example, do some species (e.g. *I. narbutii* O. Fedt., *I. fosteriana*) have comparatively large deflexed inner segments which are (at least to the human eye) brightly coloured, apparently leading potential pollinators away from the pollination tunnel at the top of the flower?

Some pollen studies have revealed significant differences between the species and it is possible that a thorough survey might assist in the overall classification of the group. Most species of Juno have spherical pollen grains, the surface architecture of which consists of discrete 'plates' of extine, and it appears, from a limited survey, that the number of 'plates' might be of value in taxonomy at the species level. Most species have several such 'plates' (e.g. c. 6-8 in *I. fosteriana*, up to 12 in *I. persica,* see Fig. 7) but in *I. aitchisonii* there are as few as three. Some species have pollen grains which are more ellipsoid in shape with one furrow, thus appearing to separate the extine into two halves (Rodionenko, 1961; 1987); Rodionenko indicated *I. drepanophylla* Aitch. and Bak. and *I. kopetdagensis* (Vved.) Math. and Wendel. as having pollen of this type; the rather divergent species *I. cycloglossa* from Afghanistan has now been found to have similar pollen grains. The geographically distinct European/North African species *I. planifolia* (Mill.) Fiori and Paoletti has grains which have a spine-covered extine, as does its close relative *I. palaestina* (Bak.) Boiss. Rodionenko (1961; 1987), partly on the basis of pollen characters and partly on features of the bulb structure, has distinguished three sections (within his genus *Juno*): sect. *Acanthospora* (spiny pollen), sect. *Juno* (flower stem dying off to base) and sect. *Physocaulon* (flower stem fleshy and persistent at base; the last of these is further subdivided into two series, series *Drepanophyllae* (with pollen extine separating into two equal halves) and series *Rosenbachianae* (with pollen extine consisting of many separate plates).

The seed morphology is also significant, some species having a rugose seed surface with few other features while others have prominent arils. Work by A. McMurtrie (pers. comm.) in Canada suggests that the species of Juno iris may be grouped partly on seed their characteristics.

CONCLUSION

Although much data exists on the species in the Juno group of Irises, at the same time it is very noticeable how little is known. The exact distributions are, in many cases, unknown, as are the habitat preferences and pollination biology. There has been no comprehensive cytological survey, partly because of the lack of availability of living material of all the species; some work by Gustafsson (1975)

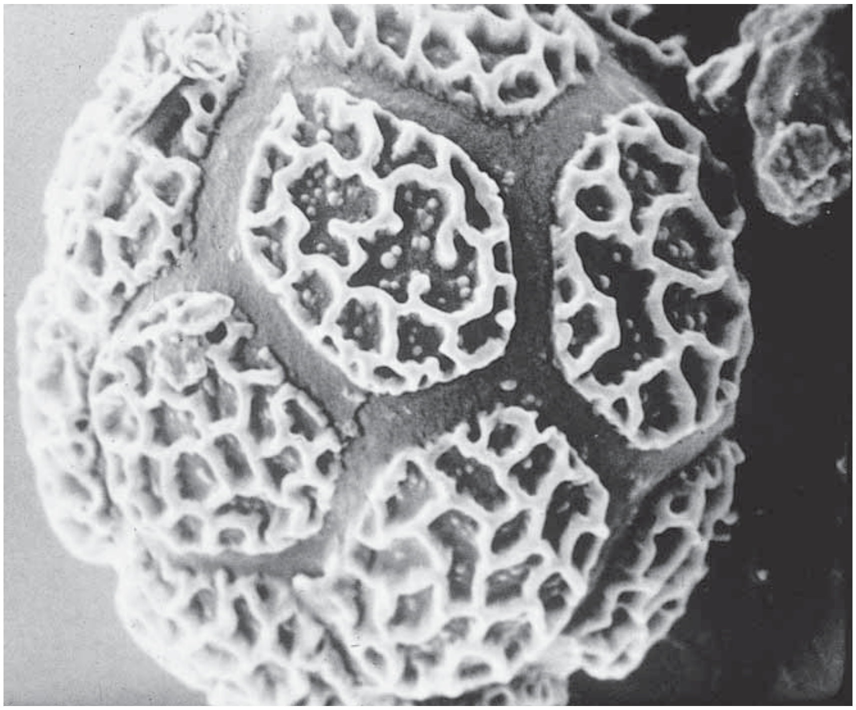

Figure 7 - Pollen grain of *Iris persica* showing surface architecture consisting of separate 'island' of extine.

suggests that this could provide valuable information. Little information exists on the morphological variability of many of the species in wild populations, and several of them are known from just a few herbarium specimens. This in itself is very unsatisfactory, since irises in general are very difficult to assess from dried material alone. Good living collections of species do exist, notably that of the Royal Botanic Gardens, Kew, but for obvious reasons, there can be only a small representation of each species. A few species are known only from their type collections and are not in cultivation. Field studies are therefore essential if there is to be any great progress in the taxonomy and understanding of the group. Especially poorly known are the species from Afghanistan which is particularly rich in Juno species and with little overlap in taxa with neighbouring countries.

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