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Hybrid Lilies Raised at the Experimental Farm of the Hokkaido University between 1950—1964

By

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Introduction

The breeding of lilies has been one of the major projects of the floriculture division of the experimental farm for about fifteen years. In our program of breeding new types of lilies, both of intra- and inter-specific crosses have been included.

Intra-specific crosses, which were crosses between two different varieties or strains within one species, were made to obtain new individuals which would fill up small gaps of flower color, blooming season, plant height, etc. between the parents. Generally, it was possible to obtain seeds and to determine the expected individuals among the offspring from these crosses within one species.

Individuals with new characters which are set far apart from the influence of one species are considered to be found only in the offspring of crosses between two different species, i. e. inter-specific crosses.

Many achievements along the line of inter-specific crosses with lilies have been made in the world, especially in Europe, United States of America and Canada. In England, Mrs. R. O. BACKHOUSE successfully crossed the purple *Lilium martagon* with the orange *L. hansonii* in the early 1890's and the resulting hybrid lilies were called *L. ×R. O. Backhouse*. C. M. HOVEY of Boston, U. S. A., cross-pollinated first *L. auratum* with *L. speciosum* in 1864. A few years later Francis PARKMAN of Boston bred *L. ×parkmanni* by a similar cross to HOVEY's. E. DEBRAS of France crossed *L. sargentiae* with pollens of *L. henryi*; one seedling from this cross flowered in 1925 and was named as *L. ×aurelianense*. L. BURBANK, U. S. A., made many species hybrids among American lily species, e. g. *LL. pardalinum*, *washingtonianum*, *humboldtii*, *parryi* and *maritimum*. His efforts were followed by D. GRIFFITH who selected a beautiful hybrid lily, *L. ×Shuksan*, in 1924.

Aurelian Hybrids or Aurelian Strains now on the market were bred by JAN DE GRAAFF of the Oregon Bulb Farm, U. S. A. Though the parentage of these hybrids is somewhat complicated, it is said to include *LL. sargentiae*, *sulphureum*, *×aurelianense* and *×T. A. Havemeyer* (4).

JAN DE GRAAFF (1) tried also to combine *L. ×hollandicum* and *L. tigrinum* and as a result of his efforts Mid-Century Hybrids and many clonal varieties have appeared in the market.

N. E. PFEIFFER of the Boyce Thompson Institute, N. Y., U. S. A., bred species

hybrids between *LL. auratum* and *japonicum* and *LL. auratum* and *rubellum*. They bloomed in 1942.

Canada, too, has been a birth place of many species hybrids of lilies. Miss Isabella PRESTON crossed *L. dauricum* with pollens of *L. davidi* var. *willmottiae* in 1929, the hybrids began to flower in and after 1932 at the Ottawa Experimental Station and were named Preston Hybrids. C. F. PATTERSON of Saskatchewan University was successful in combining *LL. cernuum*, *davidi* var. *willmittiae* and *tigrinum*. Hybrids from these combinations have added a greater variation of flower color to the Preston Hybrids.

Japan is a natural haunt of many beautiful kinds of wild lilies. This fact might be one of the reasons why there have been but a few efforts in the breeding of hybrid lilies. Japan has been cultivating lilies for more than two hundred years. Thus virus and other diseases affecting lily plants have been wide-spread and always seem to stand in the way of successful lily breeding.

Hokkaido is an island located to the north of Japan Proper and has been newly developed over the past one hundred years or so. Therefore it is expected that Hokkaido will be a more suitable place for lily breeding than Japan Proper.

In the present paper, the writer wishes to introduce thirteen new species hybrids of lilies which were raised at our experimental farm between 1950—1964.

Parent species and method of cross-pollination

The parent species used here are all Japanese or Asiatic plants which have been cultivated at the experimental farm, Sapporo, Japan, for 20 to 30 years. The names and characters of them are shown in Table 1.

Table 1. Parent species and their characters

Species name	Season of Bloom in Sopporo	Plant Height (cm)	Dominant Flower Color	Flower Form	Under-ground Stem	Bulbils
<i>*maximowiczii</i>	late July	130	Orange red, spotted black	recurved	stoloniform	none
× <i>maculatum</i> (type)	late July	60	orange, spotted black	erect	erect	none
× <i>maculatum</i> 'Kisukashi'	early July	50	orange yellow, a few spots	erect	erect	none
<i>auratum</i>	mid-Aug.	100	white, golden banded	bowl	erect	none
<i>japonicum</i>	early July	70	pink	trumpet	erect	none
<i>**tigrinum</i> var. <i>flaviflorum</i>	mid-Aug.	80	yellow, spotted black	recurved	erect	many
<i>dauricum</i> 'Kogane'	late June	40	orange yellow, a few spots	erect	erect	none
<i>amabile</i>	early July	50	lacquer red, black spots	nodding	erect	none
<i>pumilum</i>	mid-June	40	rich lacquer red	nodding	erect	none
<i>pumilum</i> 'Golden Gleam'	mid-June	40	orange yellow	nodding	erect	none

Species name	Season of Bloom in Sapporo	Plant Height (cm)	Dominant Flower Color	Flower Form	Under-ground Stem	Bulbils
×Akatsuki	early Aug.	80	scarlet	recurved	stoloniform	none
× <i>batemanniæ</i>	early Aug.	70	light orange red	erect	stoloniform	none
<i>callosum</i> var. <i>flaviflorum</i>	late Aug.	50	yellow	nodding	erect	none
<i>concolor</i> var. <i>coridion</i>	early July	40	lemon yellow, a few spots	erect	erect	none
<i>hansonii</i>	late June	80	orange yellow, brown spots	recurved	erect	none
<i>medoloides</i>	early July	80	reddish orange, black spots	recurved	erect	none
<i>speciosum</i> var. <i>rubrum</i>	mid-Aug.	100	crimson, spotted crimson	recurved	erect	none

*: syn. of *L. leichlinii* var. *maximowiczii* BAKER

** : syn. of *L. lancifolium* var. *flaviflorum* MAK.

The climatic situation of Sapporo is as follows: the mean temperature of month is highest in August being about 22°C, and lowest in January being about -4.7°C. The rainfall per annum is about 1050 mm, September being the most rainy month with about 140 mm. The snow depth reaches 80-100 cm in February. The sunshine hours per month during growing season, amount to 164-234. The last and first frost appear in early May and early October respectively.

All cross-pollinations were made outdoors in the field. The flowers of the seed parent were castrated one or two days before they opened and the stigmas were protected by covering with straw, to prevent pollen contaminations. Expected pollens were placed on the stigmas the day or one day after flowers opened. Pollen grains used were fresh but in some cases they were stored dry and cold (0-5°C) for a few months until the seed parents came to flower.

Hybrid lilies grown to flowering size

More than 150 crosses between 2 different species were made during the recent 15 years, out of which 32 crosses gave seeds with both embryo and endosperm. In some combinations, however, the grown seeds were abnormal showing juicy or jelly like endosperm and twisted embryos, and the majority failed to germinate by usual culture technics on the germinator (3).

Some hybrid seedlings failed to grow to blooming size because of various cultural failures (disease, freezing and other adverse circumstances). Some are still growing but have not yet reached the bloomig size.

Seedlings from the remaining thirteen combinations, as shown in Table 2, continued to grow successfully and flowered by the summer of 1964.

Generally speaking, most of the seedlings from crosses between two different species have intermediate characters of the parents as seen in examples of Table 2

Table 2. Hybrid lilies, their parentage and years of cross and first bloom

Names of hybrids	Seed parent	Pollen parent	Year of cross	Year of first bloom
Akaiwa	<i>maximowiczii</i>	× <i>maculatum</i> (type)	1953	1956
Yamasasa	<i>auratum</i>	<i>japonicum</i>	1955	1959
Hikari	<i>tigrinum</i> var. <i>flaviflorum</i>	<i>dauricum</i> 'Kogane'	1955	1957
Hirakoma	<i>maximowiczii</i>	<i>amabile</i>	1955	1957
Hiraito	<i>maximowiczii</i>	<i>pumilum</i>	1957	1960
Tsukiha	×'Akatsuki'	<i>pumilum</i> 'Golden Gleam'	1957	1963
Tsukita	×'Akatsuki'	× <i>batemanniae</i>	1957	1960
Sugehime	<i>callosum</i> var. <i>flaviflorum</i>	<i>concolor</i> var. <i>coridion</i>	1961	1963
Takekuru	<i>hansonii</i>	<i>medeoloides</i>	1956	1960
Shikayama	<i>speciosum</i>	sister seedling of 'Jillian Wallis'	1960	1964
Onihiko	×Nioo	×Hirakoma	1959	1961
Karakoma	× <i>maculatum</i> 'Kisukashi'	×Hirakoma	1957	1960
Nioo	<i>tigrinum</i> var. <i>flaviflorum</i>	× <i>maculatum</i> 'Kisukashi'	1955	1957

and in the following description on the characters of the hybrids. It will be important for the breeder to select such individuals from the offspring that have received the better characters of the parents.

Characters of thirteen hybrid lilies

1) Akaiwa (*maximowiczii*-*maculatum*) Hybrids (Plate-fig. 5)

All seedlings from this cross have outward and slightly downward facing flowers blooming in late July. The flower color ranges from orange red to orange with numerous black spots. More than half of the offspring have stoloniform habit (as WOODCOCK and STEARN described (4)) of underground stems.

2) Yamasasa (*auratum*-*japonicum*) Hybrids (Plate-fig. 4)

These seedlings are similar to PFEIFFER's Cameo Hybrids. Leaves and flowers of the hybrids resemble the pollen parent but a few crimson spots appear at the throat of the flower. Flower colors range from pale pink to almost white. These are so susceptible to virus diseases that we hope to find more resistant individuals out of a number of seedlings of this hybrid. Blooming season is around mid-July.

3) Hikari (*tigrinum flaviflorum*-*dauricum* 'Kogane') Hybrids (Plate-fig. 1)

10 seedlings were grown to flowering size, 6 of which had bulbils and 4 did not. All have flowers facing outwards or slightly downwards, blooming in mid-July. Flower colors range from orange to orange yellow with black spots.

4) Hirakoma (*maximowiczii*-*amabile*) Hybrids (Plate-fig. 6)

128 seedlings were grown, 14 of which showed stoloniform while the majority showed erect habits of underground stem. Flower colors range from orange red

to lacquer red with black spots. The flowers bloom in early to late July according to the individual. All of them have recurved flowers as in the parents and some individuals are highly resistant to virus diseases.

5) Hiraito (*maximowiczii-pumilum*) Hybrids (Plate-fig. 8)

5 seedlings were grown to flowering size. The growth of the underground stems were erect. Flowers are nodding and lacquer red with a few spots in two individuals but without spots in others. Slender stems of 100-150 cm high are covered thickly with white down. No underground bulblets were seen. Leaves are scattered, linear or linear lanceolate and dark green. The blooming season is mid-July. A high resistance to virus diseases was noted.

6) Tsukiha (\times Akatsuki-*pumilum* 'Golden Gleam') Hybrids

12 seedlings were grown to flowering size. The underground stem of one showed stoloniform habit while the others were erect. They have nodding and scarlet flowers faintly spotted brown. The slender stem grew from 80 to 120 cm high with scattered, linear or linear lanceolate and pale green leaves. No underground bulblets were seen and a high resistance to virus diseases was noted. The blooming season is mid-July.

7) Tsukita (\times Akatsuki- \times *batemanniae*) Hybrids (Plate fig. 2)

5 seedlings were grown to flowering size. The colors ranged from orange to orange red according to the individual. Both seed and pollen parents had no spots on the face of flowers, nevertheless all flowers of the hybrids had many black spots. Underground stems were stoloniform and had many bulblets. They bloom in middle to late July.

8) Sugehime (*callosum flaviflorum-concolor coridion*) Hybrids (Plate-fig. 7 and 13)

3 seedlings of this cross were raised. They have slightly downward facing flowers, the segments show moderate recurving. One of the three seedlings had clear yellow flowers and the other two had orange yellow flowers without spots or with faintly brown spots. It is interesting to note that they grow 100-150 cm high with sturdy stems which exceed both parents. They have no underground bulblets. The blooming season is late July.

9) Takekuru (*hansonii-medeoloides*) Hybrids (Plate-fig. 12)

This hybrid is similar in its parentage to F. L. SKINNER's hybrids. We have grown 4 seedlings to flowering size. They resemble the seed parent (*hansonii*) in characters of leaf shape, number of leafwhorls, plant height and blooming season, but have orange to scarlet flowers and red pollen which are similar to the pollen parent (*medeoloides*). They grow 80-120 cm high and flower in late June.

10) Shikayama (*speciosum-auratum*) Hybrids (Plate-fig. 10)

2 seedlings from the cross of *auratum* \times *speciosum* were grown in our field prior to 1960. These had particularly flat flowers resembling *L. \times* Jillian Wallis. In 1960 the writer attempted to improve the depth of flowers by back-crossing them to red *speciosum*. From this cross 4 seedlings were grown to flower. One of

them had flowers with segments recurving to the same degree as *speciosum* but the other three had segments moderately recurving, 15 to 18 cm across and were colored crimson.

- 11) Onihiko (*maximowiczii-amabile-tigrinum flaviflorum*- \times *maculatum*)
Hybrids (Plate-fig. 11)

32 seedlings, which were grown to flower, were exceedingly vigorous and grew 120-200 cm high. Flowers are nodding, slightly downward or outward facing differently according to the individual. Flower colors range from yellowish orange to orange red with some black spots. Some individuals have stoloniform and others have erect underground stems.

- 12) Karakroma (\times *maculatum-maximowiczii-amabile*) Hybrids (Plate-fig. 9)

26 seedlings of this cross have flowered. One of them has erect flower but the other 25 seedlings have outward or slightly downward facing flowers. The flower color ranges from yellowish orange to orange red with some black spots. About half of all seedlings have white down on their flower buds but the others do not. Underground stems grow erect and they bloom in early to mid-July.

- 13) Nio (*tigrinum flaviflorum*- \times *maculatum* 'Kisukashi') Hybrids (Plate-fig. 3)

106 seedlings from this cross have flowered. Only 2 of them had erect flowers and the majority had outward or slightly downward facing flowers. 77 seedlings had bulbils on leafaxils and 29 did not. The flower color ranges from yellowish orange to orange red with black spots. They bloom in middle through to late July. Some individuals are very resistant to virus diseases.

Discussion

The degree of cross compatibilities between two different lily species varies according to the combinations. One species may be perfectly compatible with certain species, but not with others. In some combinations the hybrid seeds produced are abnormal, while normal seeds may grow from reciprocal pollinations.

The first step of successful lily breeding by inter-specific crosses is to find the cross compatibilities between different species and to collect good hybrid seeds. The second step is to grow the hybrid seedlings properly to flowering size. This requires at least 2 to 5 years. Various problems stand in the way of growing the seedlings such as virus diseases affecting lily plants, etc. In our program of lily breeding, the hybrid seeds are germinated in the greenhouse in January and February, young plants are grown there until the last frost. Then they are planted in beds which are prepared outdoors and are covered by a fine net to protect seedlings from aphides. The soil of the bed is sterilized completely before planting the seedlings (2).

Now, what is the most probable expectation from the hybrid lilies? As seen in the characters of the hybrids above mentioned, the hybrids have mostly intermediate characters between parent species. For example, Fig. 1 shows the

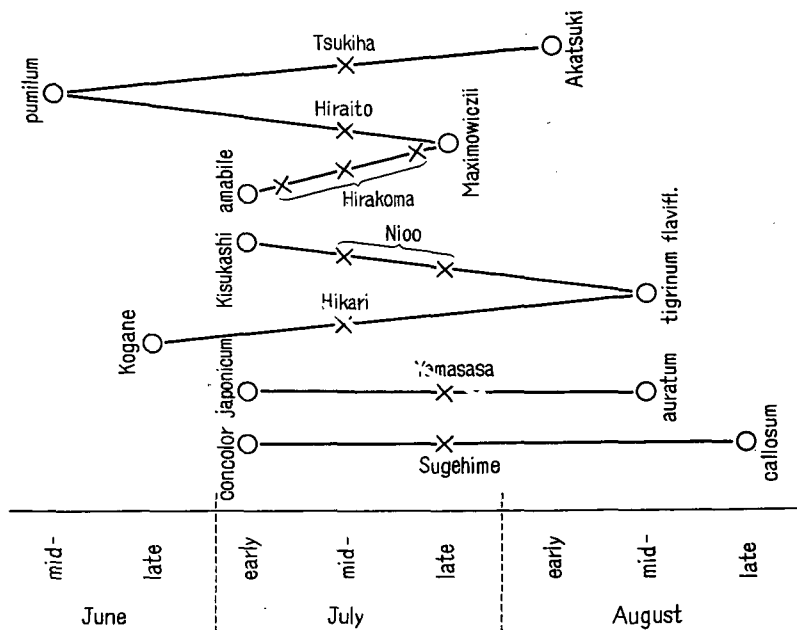


Fig. 1. Diagram showing the blooming season of hybrids (X) and their parent species (O).

blooming seasons of the hybrids which are the intermediates of parents in every case. Tsukita Hybrids are one exception to this general rule, since its flowers have many black spots in contrast with the spotless flowers of both parents. The reason for this may be that the parents are not natural species but may be of hybrid origin though their parentage is unknown.

Thus we can breed lilies which are more resistant to virus diseases, earlier flowering, taller plants, etc. than one of the parents by using another parent with further higher degree of characters.

In a very few cases, we can expect the phenomenon of hybrid vigor to appear as seen in Sugehime Hybrids which are sturdier, taller plants and with larger flowers than both parents.

Summary

1. Thirteen hybrid lilies have been raised at the experimental farm of the Hokkaido University during the last fifteen years.
2. Origins and characters of these hybrids were described.
3. Characters of the hybrids were generally intermediate between the parents when they were natural species, but the hybrids from crosses between species of hybrid origins, did not follow this rule.
4. The phenomenon of hybrid vigor was seen in Sugehime Hybrids.

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最近 15 年間に北海道大学農学部付属農場で育成された 花ゆりの種間雑種について

明 道 博

摘 要

(1) この 15 年間に 13 組合せによる種間雑種が育成された。

(2) それらの雑種名と交雑組合せはつぎの通りである。あかいわ (あかひらとゆり×いわとゆり), やまささ (やまゆり×ささゆり), ひかり (おうごんおにゆり×こがねすかし), ひらこま (あかひらとゆり×こまゆり), ひらいと (あかひらとゆり×いとはゆり), つきは (あかつきゆり×きいとばゆり), つきた (あかつきゆり×たつたゆり), すげひめ (きすげゆり×きひめゆり), たけくる (たけしまゆり×くるまゆり), しかやま (かのかゆり×(やまゆり×かのかゆり)), おにひこ (におう×ひらこま), からこま (きすかし×ひらこま), におう (おうごんおにゆり×きすかし)。

なお, これら雑種の主な特性について述べた。

(3) 雑種の形質は, 両親が野生種の場合は大体両親の中間形をとったが, 雑種起源と思われる両親間の雑種は中間形およびそれ以外の広い範囲で変異した。

(4) 雑種強勢と思われる現象がきすげゆり×きひめゆりの雑種に見られた。



Fig. 1 Hikari, clone No. 1



Fig. 2 Tsukita clone No. 5



Fig. 3 Nioo, clone No. 4

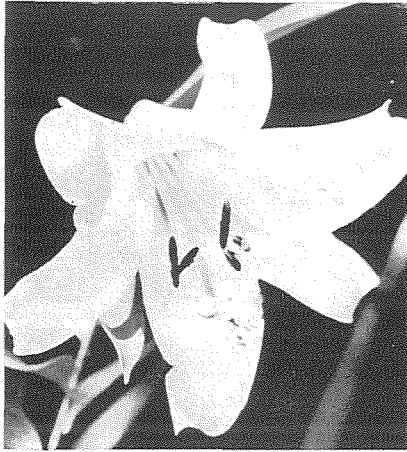


Fig. 4 Yamasasa, clone No. 1



Fig. 5 Akaiwa, clone No. 1



Fig. 6 Hirakoma, mixed seedlings

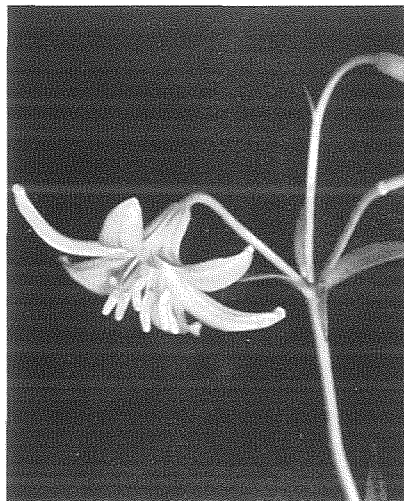


Fig. 7 Sugehime, clone No. 1

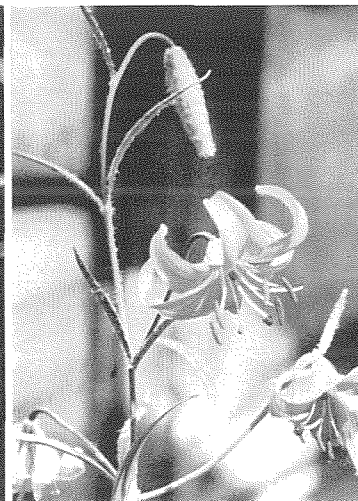


Fig. 8 Hiraito, clone No. 1



Fig. 9 Karakoma, clone No. 2



Fig. 10 Shikayama, clone No. 1



Fig. 12 Takekuru, clone No. 1



Fig. 11 Onihiko clone No. 1

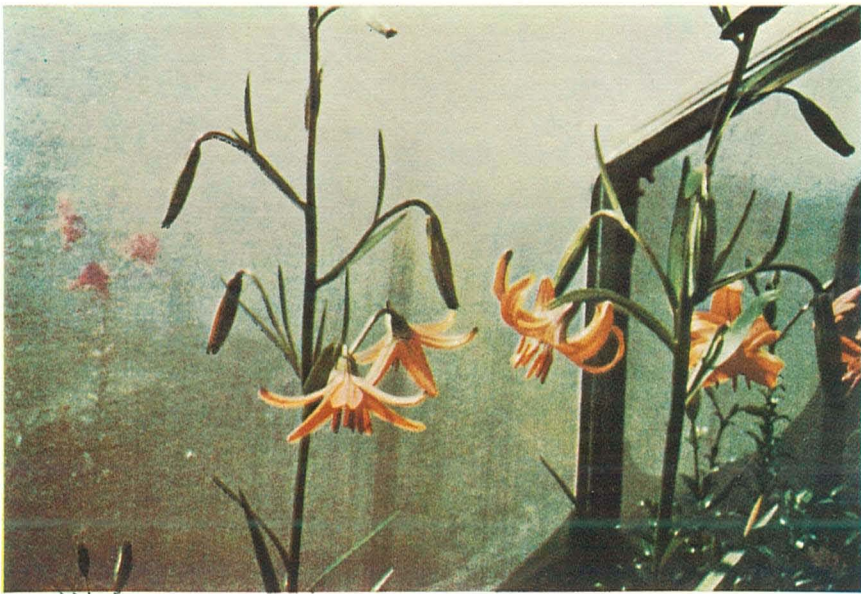


Fig. 13 Sugehime, mixed seedlings



Fig. 11 Onihiko clone No. 1

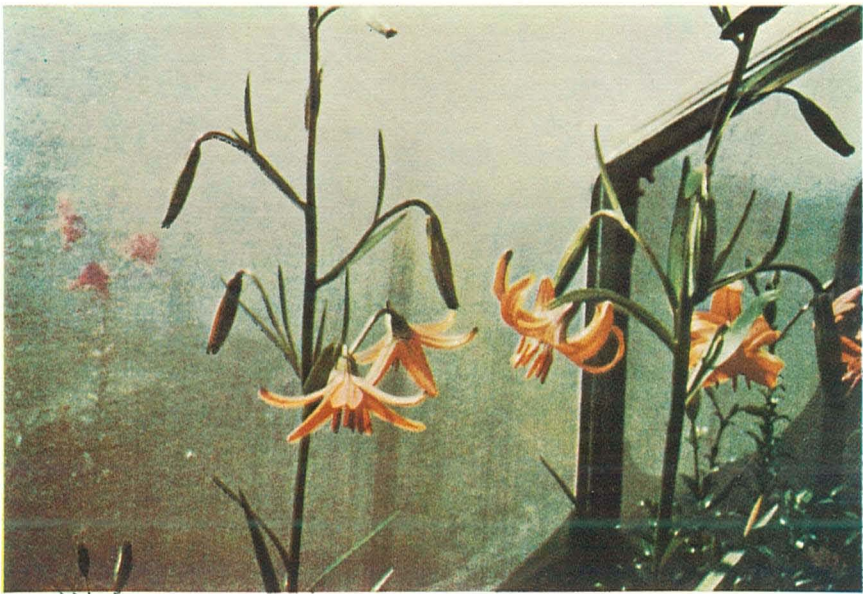


Fig. 13 Sugehime, mixed seedlings