Influence of Bulb Stock Origin, Inflorescence Harvest Stage and Postharvest Evaluation Conditions on Cut Flower Longevity of Asiatic Hybrid Lilies

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ABSTRACT. To improve the ability to discriminate between Asiatic hybrid lilies (*Lilium* L.) with regard to cut flower longevity in breeding trials, sources creating nongenetic variation during the preharvest, harvest, or postharvest phases were identified. The bulb stock origin (grower) and evaluation temperature caused only small nongenetic variation in individual flower longevity. In contrast, the developmental stage of floral buds, when cut, produced significant nongenetic variation in flower longevity. This variation could be reduced by delaying harvest. An evaluation temperature of 17 °C was optimal to discriminate between longevity levels compared to 14 and 20 °C. Flower deformation due to withering of the petals was an improved criterion for the termination of flower longevity and was preferred instead of loss of turgor of the petals. Standard conditions for screening and selecting Asiatic hybrid lilies for individual flower longevity after cutting are proposed.

In The Netherlands, lily cultivation has increased from about 250 ha to about 3600 ha in the past 25 years. About two-thirds of the bulbs is exported whereas about one-third of the bulbs is used for year-round flower production in greenhouses. Currently, the lily is the second bulb crop after tulip for cut flower production in The Netherlands, with the Asiatic hybrid lilies as an important group. Flower longevity is a primary limiting character of cut flower quality. To prolong the longevity of Asiatic hybrid lilies, pretreatment with silver thiosulfate (STS) is obligatory at the Dutch auctions. Alternative methods for improving longevity of the lily flower must be developed to reduce environmental pollution with the heavy metal silver. Although STS can retard senescence in lilies (Nowak and Mynett, 1985; Swart, 1980), the possibilities for extending flower longevity in the currently available genetic stocks are limited. Breeding and selection techniques to improve the genetic potential could be a less-polluting alternative for improving lily flower longevity.

The expression of genetic characters depends on the trial conditions. Flower longevity is a difficult genetic character to assess, since it can be affected by conditions before harvest, the developmental stage of the flowers at harvest, and postharvest conditions (Halevy and Mayak, 1979). To optimize the screening and selection procedures, environmental variance should be reduced. Therefore, a standardized test with a minimum variation in flower longevity within genotypes and a high degree of variation among genotypes is needed. For standardization, understanding the parameters which influence flower longevity is necessary.

Lilies produce several flowers per stem, and longevity can be defined in terms of inflorescence longevity as well as individual

flower longevity. Individual flower longevity appeared to be a preferable parameter for longevity evaluation in breeding trials compared to inflorescence longevity because it showed less nongenetic variation (Van der Meulen-Muisers and Van Oeveren, 1996). Although lily inflorescence longevity has been the object of many studies, to our knowledge, information about individual flower longevity is lacking.

Lily bulbs are propagated vegetatively and are genetically identical within genotypes; however, bulb growing conditions can cause physiological changes in lily flower bulbs (Van der Boon and Niers, 1986) and potentially affect flower longevity. Plant forcing conditions and season influence lily inflorescence longevity (Swart, 1980) and likely affect individual flower longevity. To reduce nongenetic variation, experiments using controlled growth chambers are preferred over greenhouse experiments.

In preliminary research, developmental stage of the floral buds at the time of harvest greatly influenced the longevity of lily inflorescences, whereas individual flower longevity hardly varied per genotype (Van der Meulen-Muisers et al., 1992). In practice, lilies are harvested in the bud stage; the stage normally depends on the cultivar assessed. In breeding trials, it is desirable to define a harvest stage more comparable among and within genotypes to reduce environmental variance and to improve the ability to discriminate between genotypes with regard to individual flower longevity.

In postharvest research, standard conditions for flower evaluation have been proposed (Reid and Kofranek, 1980). These conditions simulate consumer environments and are based on the determination of the commercial display life of marketable genotypes. In contrast, only one or a few plant characteristics per evaluation are considered in selection trials to develop new genotypes. Other evaluation conditions may be more discriminative for detecting genetic differences within the genotypes (Van Eijk and Eikelboom, 1986). Various interpretations of the definition of flower longevity influence the data and selection results (Van Eijk and Eikelboom, 1977). In a breeding program, criteria for indicating the start and end of flower life have to be uniform to discriminate among longevity levels of a large group of genotypes in a consistent way.

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The objective of the present research was to determine screening conditions with sufficient sensitivity to discriminate between different longevity levels in Asiatic hybrid lilies. The influence of bulb stock origin, inflorescence harvest stage, and evaluation conditions on environmental variance in individual flower longevity were examined.

Materials and Methods

PLANT MATERIALS. Bulbs of Asiatic lily hybrids, 12 to 16 cm in circumference, were obtained either from commercial growers in The Netherlands or from the CPRO-DLO lily collection in 2 successive years. The choice of the genotypes was based on known differences in individual flower longevity. The bulbs were stored in moist peat at -2°C for about 5 months until planted.

FORCING CONDITIONS. Plants were forced in a growth chamber of the CPRO-DLO Selektion (Smeets, 1986), with a constant 17°C air temperature, 60% relative humidity (RH), and a 16-h photoperiod. Photosynthetically active radiation (PAR) (400 to 700 nm) at the top of the plants was kept at a photosynthetic photon flux density (PPFD) of about $112\ \mu\text{mol}\cdot\text{s}^{-1}\cdot\text{m}^{-2}$ using high-pressure metal halide lamps (HPI-T 400W, Philips). Plants were grown individually in 2.5-L plastic pots using a standard prefertilized commercial potting soil. No additional fertilization was used and plants were irrigated daily.

HARVEST CONDITIONS. Lily inflorescences were harvested at anthesis of the most mature floral bud by cutting the stems at the soil level within four hours after onset of the photoperiod. The leaves on the basal 15 cm were removed and individual inflorescences were placed in 1-L glass flasks containing about 500 mL tap water.

POSTHARVEST CONDITIONS. Cut inflorescences were held at a constant 17°C air temperature, 60% RH, and a 12-h photoperiod. PAR (400 to 700 nm) at the top of the inflorescences, was about $14\ \mu\text{mol}\cdot\text{s}^{-1}\cdot\text{m}^{-2}$ using fluorescent lamps (TL-D84 36W, Philips). Each individual flower was observed daily within 4 to 6 h after onset of the photoperiod. Flower longevity was recorded as the time between anthesis and deformation of the flower, which was usually due to visual withering of the petals. Individual flower longevity, calculated as the mean flower longevity per stem, was used as a parameter for screening (Van der Meulen-Muisers and Van Oeveren, 1996).

BULB STOCK ORIGIN (EXPT. 1). To ascertain the influence of bulb stock origin (grower) on individual flower longevity, 10 cultivars were used (Table 1). Bulbs of a varying number of origins were obtained per cultivar within the same year. Plants were forced, harvested and evaluated for longevity as described above. For each cultivar, individual flower longevity data of nine inflorescences per bulb stock origin were used for statistical analyses.

INFLORESCENCE HARVEST STAGE (EXPT. 2). To determine a harvest stage with minimum variation in flower longevity within genotypes after harvesting and allowing maximum variation between genotypes, 16 cultivars were used (Table 2). Plants were forced and evaluated for flower longevity as described above. Three stages of floral bud development at the time of cutting were used. The first two stages were based on color gradation of the most mature floral bud: stage 1, just starting to color; stage 2, fully colored; stage 3, at anthesis of the most mature floral bud. Data on time to anthesis of the first two harvest stages and data on flower longevity and percentage of flowers that reached anthesis of all three harvest stages were used for statistical analyses. Seven inflorescences were used per treatment combination.

EVALUATION CONDITIONS (EXPT. 3). Thirty-five lily genotypes

consisting of twenty-five cultivars, eight tetraploid genotypes, and two species were used in the experiment (Table 3). These genotypes were examined to determine a criterion for end of flower life and to ascertain an evaluation temperature for screening on individual flower longevity in lily breeding. Plants were forced as described above and harvested at anthesis of the most mature floral bud. Two criteria were compared to define the end of the life of each flower: 1) loss of turgor of the petals and 2) flower deformation. The loss of turgor was determined by tactile sense, while flower deformation was determined by visual detection of withering, which usually started at the tip of the petals. All flowers were evaluated using both criteria. Three air temperatures (14, 17, and 20°C) were used during the evaluation of flower longevity. In each genotype, flower longevity data of five inflorescences per evaluation temperature were used for statistical analyses.

STATISTICS. Whole plants were used as experimental units in completely randomized designs. Data were analyzed by analysis of variance and variance components were estimated using the Genstat 5 Statistical Package (Rothamsted, U.K.). Ratios of genotypic variance and total variance, defined as broad-sense heritabilities, were used to compare the screening efficiency between treatments. Heritabilities were calculated as $H^2 = s_g^2 / (s_g^2 + s_e^2/n)$, where s_g^2 denotes genotypic variance, s_e^2 denotes environmental variance, and n is the number of plants per genotype. All calculations were carried out for $n=1$, representing the early stage of selection (individual plant level). To compare the ranking of the genotypes between treatments, correlation coefficients (r) were calculated.

Results and Discussion

BULB STOCK ORIGIN (EXPT. 1). Flowers of the same genotype obtained from bulbs produced by different growers did not significantly vary in individual flower longevity (Table 1). Variance in individual flower longevity between bulb origins of the same genotype was relatively small compared to genotypic variance (0.12 and 1.17, respectively).

Lily bulbs are propagated vegetatively and are, therefore, genetically identical within genotypes. Genetic variation between production lines of the same genotype could occur due to spontaneous mutations. This phenomenon is more likely to take place in long existing cultivars than in more recently released cultivars. Longevity differences within long existing cultivars like 'Harmony' and 'Connecticut King' (Leslie, 1982) were 1 day at most (found within 'Connecticut King') when different bulb origins were compared (Table 1).

Table 1. Flower longevity (days) of 10 Asiatic lily hybrids using bulb stocks originated from a varying number of commercial growers per genotype; $n = 9$ inflorescences, SED = 0.57.

Genotype (year of introduction) ^a	Bulb stock origin (grower)			
	1	2	3	4
Avignon (1984)	7.2	7.6		
Bright Beauty (1982)	4.4	4.9		
Connecticut King (1967)	7.6	7.7	8.2	8.5
Harmony (1950)	5.5	5.6		
Ladykiller (1974)	4.9	5.5		
Monte Rosa (1984)	6.5	7.3	7.5	
Montreux (1984)	5.5	6.4		
Pollyanna (1981)	6.1	6.2	6.3	
Red Night, syn. Roter Cardinal (1974)	5.2	5.4		
Sirocco (1984)	4.7	5.6		

^aFrom Leslie (1982).

Variation for bulb growing conditions can cause physiological differences between lily bulbs of different production units (Van der Boon and Niers, 1986). These differences may influence plant quality in lily (Beattie and White, 1993; Miller, 1993) and could also lead to nongenetic variation in individual flower longevity. The data (Table 1) indicate that using bulbs of the same genotype produced by different growers will not greatly influence individual flower longevity. Bulb stock origin (grower) was a minor source of variation for individual flower longevity and was not standardized in the experiments.

INFLORESCENCE HARVEST STAGE (EXPT. 2). Data on time to anthesis, flower longevity, percentage of buds that reached anthesis, and number of floral buds per stem of 16 genotypes are presented in Table 2.

TIME TO ANTHESIS. Analyses of variance showed that the effects of genotype and harvest stage on time to anthesis of the most mature floral bud were highly significant ($P \leq 0.001$), but no significant interaction was found between genotype and harvest stage. Harvesting lily inflorescences based on color gradation (harvest stages 1 and 2) resulted in a significant decrease in time from harvest to anthesis of the most mature floral bud if harvest was delayed (Table 2). Environmental variance (s^2_e) was decreased by delaying harvest, while the genotypic variance (s^2_g) hardly changed (Table 2).

In commercial situations and postharvest research, coloration of floral buds is a common method to define harvest stage (Han, 1992; Spikman, 1989). However, in selection trials, the first goal should be to discriminate among a group of genotypes in a comparable way based on each selection character. Differences in developmental stage of the floral buds among genotypes resulted in different time intervals from harvest to anthesis when using a subjective harvest criterion, based on color gradation. These subjective criteria also influenced uniformity in developmental

stage per genotype, causing high environmental variances. This undesirable nongenetic variation, was reduced by delaying harvest. Anthesis of the most mature floral bud (stage 3) would represent the most comparable harvest stage, among and within genotypes. This should be preferable in breeding trials.

FLOWER LONGEVITY. Analyses of variance showed that the effect of both genotype and harvest stage on individual flower longevity was highly significant ($P \leq 0.001$), while the interaction between genotype and harvest stage was not significant. The effect of harvest stage on individual flower longevity was relatively small compared to the genotype effect. Heritability increased by delaying harvest. Heritability was greatest at harvest stage 3, since the reduction in genotypic variance compared to harvest stage 2 was compensated by the reduction in environmental variance (Table 2). In general, the average percentage of flowers that reached anthesis increased with the maturity of floral buds at the harvest time (Table 2). The percentage of open flowers per genotype varied from 28% to 99% for 'Ladykiller' to 100% for all three harvest stages within 'Bora' and 'Monte Rosa' and appeared to be independent of the mean number of buds per stem (Table 2).

Longevity is often determined by harvest stage, due to the influence of the harvest stage on developmental factors like carbohydrate level and sensitivity to environmental stress (Halevy and Mayak, 1981; Spikman, 1989). Variation in inflorescence longevity of Asiatic hybrid lilies is known to be caused by harvest stage (Van der Meulen-Muisers et al., 1992), which influences the percentage of flowering buds. The observed effect of harvest stage on longevity of individual flowers was relatively small, despite the varying impact on percentage of open flowers between genotypes (Table 2). Screening efficiency, measured by heritability, improved with the maturity of floral buds at the harvest time. This improvement was mainly due to a decrease in environmental variance (Table 2).

Table 2. Days to anthesis, flower longevity (days), percentage of flowers that reach anthesis, and number of floral buds per stem of 16 Asiatic lily hybrids. Inflorescences were harvested at the time the most mature floral bud started to color (stage 1), was fully colored (stage 2), or showed anthesis (stage 3); $n = 7$ inflorescences.

Genotype	Days to anthesis		Flower longevity (d)			Open flowers (%)			Floral buds per stem
	Harvest stage		Harvest stage			Harvest stage			
	1	2	1	2	3	1	2	3	
Adelina	7.6	3.6	6.4	6.7	7.0	61	90	100	9.7
Apeldoorn (syn. Amsterdam)	8.0	3.9	6.0	5.9	5.9	30	46	85	9.9
Bora	8.2	3.9	6.6	7.6	7.6	100	100	100	5.4
Dreamland	8.0	3.3	6.2	6.4	6.4	64	89	99	10.1
Enchantment	9.0	3.6	5.6	5.9	5.9	87	96	96	7.8
Eurovision	8.4	2.9	6.3	6.5	6.7	70	92	99	9.0
Figaro	7.6	4.0	5.7	6.4	6.5	72	97	97	7.5
Gran Sasso	7.3	2.0	7.1	7.5	7.7	98	98	100	7.1
Ladykiller	8.7	4.4	5.9	5.6	6.0	28	72	99	10.5
Lavender Dream	7.5	2.7	5.5	5.9	5.9	56	91	100	7.8
Mont Blanc	7.0	2.1	7.4	8.1	7.9	96	86	100	6.6
Monte Negro	7.5	2.7	7.2	7.1	6.8	58	78	94	7.8
Monte Rosa	6.4	2.3	8.1	8.7	8.2	100	100	100	5.2
Napoli	6.7	2.9	6.2	6.8	7.1	96	99	100	9.9
Orange Mountain	7.6	3.7	5.3	6.0	6.8	93	100	100	11.7
Sahara	5.1	1.6	7.2	6.8	7.0	54	83	76	6.0
Mean	7.6	3.1	6.4	6.7	6.9	73	89	96	8.3
SED ^z	0.17		0.09			2.0			
s ² _g	0.58	0.55	0.47	0.68	0.52				
s ² _e	2.15	0.85	0.60	0.44	0.17				
H ²			0.44	0.61	0.75				

^zStandard error of differences between harvest stages averaged over cultivars.

The results indicate that undesirable variance caused by harvest stage can be reduced by harvesting lily inflorescences in a more mature stage. By delaying harvest, a larger uniformity with respect to stage of development can be expected and the ability to discriminate between genotypes with respect to individual flower longevity will be increased. Therefore, harvesting lilies at anthesis of the most mature floral bud will be used in the CPRO-DLO breeding program. In practice, newly bred cultivars will be harvested in an earlier stage of development. This may change the percentage of buds that reach anthesis, but only small differences in individual flower longevity can be expected. Different harvest stages have to be recommended per cultivar to obtain the optimum ornamental value, since it is a function of individual flower longevity and percentage of flowering buds.

EVALUATION CONDITIONS (EXPT. 3). The analyses of variance gave highly significant effects of genotype, evaluation criterion,

and evaluation temperature on individual flower longevity. The two-factor interactions were also significant, but their contribution to the total variance was relatively small. The three-factor interaction was not significant.

EVALUATION CRITERION. Loss of turgor of the petals was significantly earlier in time than deformation of the flower for each temperature assessed (Table 3). Although the effect of genotype $\times$ criterion was significant, ranking the genotypes based on longevity varied little between the two evaluation criteria. Correlation between longevity levels of the genotypes using two evaluation criteria was highly significant for all three evaluation temperatures ($r_{14^\circ\text{C}} = 0.86$, $r_{17^\circ\text{C}} = 0.87$, $r_{20^\circ\text{C}} = 0.89$). These high correlations indicated that the interaction between genotype and criterion was not a main factor determining flower longevity. For each temperature considered, heritability of flower longevity was the highest if flower deformation was used as the criterion for termination of

Table 3. Flower longevity (days) of 35 Asiatic lily hybrids using two criteria to determine the end of flower life at three evaluation temperatures; n = 5 inflorescences.

Genotype	Days to loss of turgor			Days to flower deformation		
	Evaluation temp ($^{\circ}\text{C}$)			Evaluation temp ($^{\circ}\text{C}$)		
	14	17	20	14	17	20
Bicolito	6.7	6.4	4.6	9.4	8.1	6.1
Bora	7.3	6.0	4.9	8.7	7.5	5.8
Bright Beauty	4.6	3.6	3.2	6.4	5.2	4.4
Connecticut King	6.7	5.4	4.6	9.7	7.7	6.2
Corsica	6.4	6.6	4.4	9.4	9.5	6.3
Dreamland	4.4	4.0	3.0	6.9	5.8	4.7
Enchantment	4.7	4.4	3.4	6.0	5.4	4.1
Ladykiller	4.4	3.7	2.8	6.6	5.1	4.0
Lavender Dream	5.9	5.0	4.0	7.2	6.3	5.0
Mont Blanc	6.5	5.9	5.0	9.0	8.3	6.4
Monte Rosa	6.3	5.8	5.0	9.2	8.6	6.6
Montreux	6.8	6.1	4.7	9.0	7.7	5.7
Napoli	7.1	5.6	4.0	9.2	7.1	5.5
Orange Aristo	5.6	4.9	3.8	7.8	6.3	5.0
Orlito	6.4	5.9	4.5	8.6	7.5	5.8
Pirate	6.2	5.6	4.1	7.4	7.2	5.0
Prominence	5.1	4.5	3.5	6.7	6.0	4.3
Red Night (syn. Roter Cardinal)	4.9	3.9	2.9	6.1	4.7	3.4
Rolito	7.1	5.8	4.8	8.6	7.7	6.3
Sarina	6.0	6.2	4.8	7.8	7.5	5.8
Sirocco	5.4	4.4	3.4	6.8	5.1	4.2
Snowstar	6.8	6.3	4.6	9.3	8.7	6.4
Whilito	5.0	4.8	3.2	6.6	6.3	4.3
Yellito	8.2	7.7	5.6	10.7	9.7	7.1
Yellow Blaze	6.6	6.2	4.5	8.6	7.0	5.0
CPRO-73139 <i>L. dauricum</i>	6.4	5.9	4.9	8.4	8.1	6.7
CPRO-77543.6 <i>L. concolor</i>	9.6	7.6	4.9	10.3	8.2	5.6
CPRO-85702.5 (4n)	5.2	4.3	4.0	7.5	6.1	5.1
CPRO-85707.1 (4n)	7.9	6.9	5.2	9.9	9.0	6.6
CPRO-85710.2 (4n)	7.1	6.1	4.1	8.8	7.5	5.5
CPRO-85774.2 (4n)	5.9	4.9	3.6	7.8	6.8	5.2
CPRO-85989 (4n)	6.0	5.6	4.6	8.0	7.6	6.0
CPRO-87205 (4n)	7.6	6.9	5.2	9.5	9.1	6.7
CPRO-901246 (4n)	6.5	4.4	4.0	8.4	6.0	5.1
CPRO-901264 (4n)	6.0	5.0	4.2	8.4	7.5	5.6
Mean (SED ² = 0.06)	6.3	5.5	4.2	8.2	7.2	5.5
s ²	1.22	1.06	0.49	1.48	1.66	0.80
s ² _e	0.40	0.30	0.20	0.28	0.26	0.22
H ²	0.75	0.78	0.71	0.84	0.87	0.78

²Standard error of differences between treatment means.

flower longevity. This was mainly due to a larger genotypic variance in combination with a smaller environmental variance (Table 3).

In postharvest research, criteria used to define termination of longevity vary from fading of the petal color and abscission of the petals to several stages of petal wilting (Halevy and Mayak, 1979). In breeding, evaluation criteria must be uniform and valid for a diverse group of genotypes (Van Eijk and Eikelboom, 1977). From preliminary experiments it was concluded that fading of petal color and abscission of petals could not be used as criteria to compare longevity levels in lily genotypes (data not shown). Color fading was difficult to score consistently, especially for the white and yellow colors. Petal abscission occurred only in some genotypes or a long time after loss of ornamental value of the flowers. Loss of turgor of the petals and deformation of the flowers occurred in all genotypes tested. The results show that flower deformation is preferable for discriminating between lilies than loss of petal turgor because of its higher heritability of flower longevity.

EVALUATION TEMPERATURE. Flower longevity significantly decreased with increasing temperatures (Table 3). In general, this decrease of longevity was more rapid at a temperature increase between 17 and 20 °C than between 14 and 17 °C. Longevity of 'Corsica' was constant at a temperature increment from 14 to 17 °C, whereas flower longevity of *L. concolor* decreased more rapidly than the other genotypes (Table 3). Although the effect of genotype $\times$ temperature was significant, ranking the genotypes based on their longevity varied very little among the temperature treatments. The correlations were high for loss of turgor of the petals ($r_{14-17\text{ }^{\circ}\text{C}} = 0.90$, $r_{14-20\text{ }^{\circ}\text{C}} = 0.82$, $r_{17-20\text{ }^{\circ}\text{C}} = 0.88$) and flower deformation ($r_{14-17\text{ }^{\circ}\text{C}} = 0.90$, $r_{14-20\text{ }^{\circ}\text{C}} = 0.87$, $r_{17-20\text{ }^{\circ}\text{C}} = 0.94$). For both criteria, heritability of flower longevity was the greatest at 17 °C and the smallest at 20 °C. The latter was mainly due to a relatively large decrease in genotypic variance at 20 °C compared to 14 and 17 °C. Environmental variance slightly decreased with an increase of evaluation temperature and was relatively small compared to genotypic variance (Table 3).

Even though highly variable genetic material (cultivars, tetraploid clones, and species) was used, the response to the different evaluation temperatures, based on longevity, hardly varied between genotypes. The deviating decrease in flower longevity of *L. concolor* with an increase of screening temperature may be due to the subordinated role of this species in the parentage of the Asiatic hybrids (Marshall, 1981). Screening efficiency was improved by evaluating the cut flowers at 14 or 17 °C compared to 20 °C because of improved discrimination. Evaluation of flower longevity at 17 °C was preferable for discriminating between genotypes in lily breeding research because of its higher heritability, particularly in combination with flower deformation as a criterion for evaluation. Evaluation of newly bred cultivars at 20 °C, as proposed by Reid and Kofranek (1980), will change longevity levels, but with only small differences in the ranking of the genotypes.

In conclusion, our results imply that bulb stock origin and evaluation temperature do not determine nongenetic variation in individual flower longevity of Asiatic hybrid lilies. Undesirable nongenetic variation dependent on the developmental stage of lily

inflorescences at harvest time could be minimized by collecting inflorescences at the anthesis of the most mature floral bud. To locate genetic differences among longevity levels of Asiatic lily hybrids, an evaluation at 17 °C was the most discriminative. An improved criterion for the termination of flower longevity was the deformation of the flower due to start of withering of the petals. This was preferred instead of loss of turgor of the petals. The harvest stage, the evaluation criterion and the evaluation temperature will be standardized in future experiments. This is done to improve the ability to discriminate between longevity levels of Asiatic hybrid lilies in breeding trials, directed toward the improvement of flower longevity.

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