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Changes in Total Soluble Sugar and Free Amino Acids in cut Raktagandha Roses as Influenced by Pre-Harvest Spray of Micronutrients

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ABSTRACT

Changes in total soluble sugars (TSS) and total free amino acids (TFAA) in petal, leaf and stem tissues of cut roses *Rosa hybrida* L. cv Raktagandha harvested from micronutrient sprayed rose bushes were studied. Micronutrient sprays consisted of $ZnSO_4$ at 0.5 and 1.0% of each, FeSO4 at 1.0 and 2.0%, $CuSO_4$ at 0.1 and 0.2%. Control plants were sprayed with distilled water. Micronutrient treatments significantly effected TSS and TFAA content in corolla, leaf and stem tissues at harvest, on 3rd day in the vase and on senescence. TSS content in corolla showed an increase on senescence irrespective of the micronutrient sprays. TSS in leaf and stem tissues showed highest at harvest followed by a decreasing trend on 3rd day in vase and on senescence for most of the micronutrient treatments. Irrespective of the micronutrient treatments an increasing trend in TFAA content in all flower tissues was shown from harvest stage, reaching a peak on senescence. Foliar spray of $FeSO_4$ (2.0%) recorded the lowest TFAA content in corolla and leaf over other treatments and comparatively lower TFAA in stem at all stages of senescence.

The changes in the concentration of the starch and the free amino acids could serve as an indication of the stage of senescence of a cut rose flower (Ferreira and Swardt 1980). Senescence of cut carnation is associated with a decrease in all sugars and as senescence progressed in cut rose cv "Forever Yours" a slight decrease in petal sugar occurred. Senescence of cut roses is associated with an increase in most of the amino acids and concengtration of TFAA (Gao and Wu 1990) in petals. In the present paper, postharvest life of the roses and the changes of total soluble sugars (TSS) and total free amino acids (TFAA) in different parts of cut roses such as corolla, leaf and stem tissues during senescence process as influenced by preharvest application of micronutrients are discussed.

MATERIALS AND METHODS

This experiment was carried out in the Division of Floriculture and Landscaping, IARI, New Delhi during 1991-92. Three years old H.T. roses cv Raktagandha of uniform size and vigour were chosen for the experiment. The plants were pruned uniformly to a length of 45 cm

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from ground level in the middle of October 1991 retaining four healthy shoots per plant. A fertilizer dose consisting of 5 gN, 8g P_2O_5 and 6 gK_2O per plant was applied after pruning. 2.5 Kg of F.Y.M. was also applied to each plant. All cultural practices and plant protection measures were attended uniformly to all plants. By the second week of November 1991 (three weeks after pruning) the plants were sprayed with micronutrients such as $ZnSO_4$ and $MnSO_4$ at 0.5 and 1.0% of each $FeSO_4$ at 1.0 and 2.0% and $CuSO_4$ at 0.1 and 0.2%. Lime [$Ca(OH)_2$] was mixed with each micronutrient preparation (except $CuSO_4$ solutions) at half the strength of the respective preparation. Control plants were sprayed with distilled water. The spray was repeated by the second week of January 1992 (two months after the first spray). Thus, there were 9 treatments which were replicated 4 times in a randomized block design. The experimental unit consisted of a single bed with 4 mature plants and there were altogether 16 plants for each treatment.

Cut roses harvested ten days onwards after the first spray of micronutrients at a stage when all sepals became well spread and one petal started unfurling from the tip were utilized for vase life study. The cut roses were harvested with a stem length of 23-25 cm in the early morning and were immediately placed in cold fresh water followed by shifting to the laboratory within one hour after harvest. The stems were recut to a uniform length of 20 cm and leaves below the 4th leaf (a compound leaf with five leaflets) from the top were removed. The stem ends (at least 3-4 cm) were dipped in distilled water (60 ml) contained in a test tube for vase life study. Four flowers were used for one replication. Vase life study was a continuation of the field experiment. The temperature and relative humidity of the laboratory were averaged at 21.63°C (maximum) and 15.96°C (minimum) and 69.76% R.H during the vase life study. Vase life was considered over when the outer petals showed blueing. Samples of cut roses were collected at the initial day, on 3rd day and on senescence during the study of postharvest life for biochemical analysis. Samples were dried at 70°C in an oven for 7 days and powdered using an electric grinder. Powdered samples which were collected after passing 20 mm mesh and homozenised in 80% ethanol alcohol were utilized for the estimation of total soluble sugars (TSS) as described by Dubois *et al* (1956) and total free amino acids (TFAA) as described by Rosen (1957). Total sugars content in the flower sample was worked out by referring a standard curve of sugar (Glucose-D) and was expressed in mg/g of dry weight. TFAA content in flower tissues was worked out referring to a standard curve of Leucine and was expressed in mg/g of dry weight (mg leucine equivalent/g of dry weight). Data collected under different characters were analysed statistically following analysis of variance technique described by Chandel (1990).

RESULT AND DISCUSSIONS

Irrespective of micronutrient sprays, it was observed, in general, that total soluble sugar in corolla showed a gradual rise on 3rd day in vase from harvest followed by sharp decrease at senescence while in the case of leaf and stem TSS content was highest at harvest followed by successive decrease on 3rd day in vase and at senescence (Table 1). Generally, corolla tissues contained highest TSS followed by leaf and stem tissues. Increase in TSS in corolla on 3rd day in the vase from harvest followed by a sharp decrease at senescence was similar to the finding of Sharma (1981) in the petals of *Rosa damascena*. Increase in soluble sugars content of rose

Table 1. Changes in the content of total soluble sugars in the corolla, leaf and stem tissue of the cut "Raktagandha" roses as affected by micronutrient sprays

	mg/g d wt in corolla			mg/g d wt in leaf			mg/g d wt in stem			
Treatments	at harvest	on 3rd day	on senes-cence	at harvest	on 3rd day	on senes-cence	at harvest	on 3rd day	on senes-cence	Vase life (days)
$ZnSO_4$ 0.5%	85.2	113.8	82.3	68.3	41.7	37.2	52.2	31.6	25.4	8.6
$ZnSO_4$ 1.0%	91.9	106.5	88.5	76.0	49.5	45.3	53.6	39.8	35.3	7.2
$FeSO_4$ 1.0%	89.0	116.3	91.0	77.5	44.8	45.7	50.7	36.5	35.7	7.8
$FeSO_4$ 2.0%	85.6	103.6	87.7	64.5	39.6	54.7	48.2	28.8	35.0	9.0
$MnSO_4$ 0.5%	91.5	111.4	91.3	73.4	42.1	57.4	53.6	33.5	32.5	7.1
$MnSO_4$ 1.0%	96.3	101.7	90.6	73.1	43.3	35.8	51.4	29.4	31.4	7.3
$CuSO_4$ 0.1%	90.5	112.3	86.0	68.4	41.9	31.3	52.7	31.2	21.2	8.6
$CuSO_4$ 0.2%	98.2	111.2	89.9	66.1	47.5	33.4	56.58	37.4	23.1	7.8
Control (D.W.)	96.1	108.4	89.8	70.0	43.2	31.3	61.8	32.66	30.3	8.0
C.D. (5%)	4.8	4.4	3.3	2.5	3.4	3.6	2.7	3.3	3.4	0.8

petals is derived largely from starch hydrolysis. The 3rd day in the vase life of cut rose was coincided with the gradual increase in the expansion of petal. Evans and Reid (1988) observed that there is a sharp rise in soluble sugar content of outer whorl coincided with the time when the rate of petal expansion increased. Highest TSS content found with corolla followed by leaf must be because of movement of some dry matter from the leaves to the petals which were also confirmed by Nichols and Ho (1979). Stem contains less amount of total soluble sugars than leaves due to rapid movement of sugars into leaves and then to flower heads.

Among the micronutrient treatments, $FeSO_4$ (2.0%) as foliar spray lengthened the vase life to the maximum (9.00 days) and though on par with $ZnSO_4$ (0.5%) and $CuSO_4$ (0.1%), showed significant increases over other treatments including control (8.00 days). Increase in the vase life with $FeSO_4$ (2.0%) spray must be because of more reserve carboydrates/photosynthates present in the flower tissues prior to harvest compared to the amount of photosynthates present in cut roses obtained from rose bushes sprayed with other micronutrients. Accumulation of photosynthates in flower tissues might be the reason for longer vase life of cut roses obtained from the rose bushes sprayed with $ZnSO_4$ (0.5%) and $CuSO_4$ (0.1%) since Zn spray was reported to increase more vegetative growth in Jasminum sambac which was correlated to increase in total chlorophyll content in leaves (Bhattacharjee 1989) and Cu plays an important role in photosynthesis as well as chlorophyll synthesis. $FeSO_4$ (2.0%) spray which recorded the longest vase life among

Table 2. Changes in the content of total free amino acids in the corolla, leaf and stem tissue of the cut "Raktagandha" roses as affected by preharvest spray of micronutrients

Treatments	mg/g d wt in corolla			mg/g d wt in leaf			mg/g d wt in stem			Vase life (days)
	at harvest	on 3rd day	on senes-cence	at harvest	on 3rd day	on senes-cence	at harvest	on 3rd day	on senes-cence	
ZnSO4 0.5%	7.4	23.8	34.0	4.1	8.9	14.1	3.5	9.6	17.7	8.6
ZnSO4 1.0%	7.86	21.2	36.6	4.9	9.9	14.1	5.7	10.9	17.2	7.2
FeSO4 1.0%	10.9	23.6	35.1	3.4	8.9	14.7	5.7	9.5	21.4	7.8
FeSO4 2.0%	7.2	20.1	30.6	3.1	8.4	12.1	3.8	8.8	16.4	9.0
MnSO4 0.5%	7.7	22.4	35.9	4.9	9.8	14.9	5.3	9.1	19.5	7.1
MnSO4 1.0%	7.8	24.2	33.1	4.8	10.7	15.4	4.8	10.2	22.7	7.3
CuSO4 0.1%	7.6	23.8	34.8	4.2	8.5	15.0	3.6	9.3	16.2	8.6
CuSO4 0.2%	8.4	20.5	38.1	5.6	10.2	14.3	4.7	10.4	18.3	7.8
Control (D.W.)	10.3	25.5	37.3	7.9	12.0	16.9	8.1	11.9	21.3	8.0
C.D. (5%)	0.4	0.8	1.7	0.6	0.4	1.00	0.4	0.7	1.1	0.8

micronutrient treatments, was also associated with significant decreases in TSS content in corolla, leaf and stem tissues at harvest and on 3rd day in the vase over control, however at senescence there was rise in TSS content in these tissues. During the process of senescence especially in the cut roses obtained from rose bushes sprayed with $FeSO_4$ (2.0%) there might be less breakdown of starch as compared to control after harvest till 3rd day in vase because $FeSO_4$ (2.0%) spray might inhibited breakdown of starch resulting in presence of more starch till 3rd day. However, increase in TSS by foliar sprays of micronutrients (Zn, Cu and Mn) were reported in cashew (Roy and Majumdar 1989), 'Dancy and Tangerine' mandarin (Singh and Singh 1981) and papaya (Ghanta *et al* 1992).

Irrespective of micronutrient treatments total free amino acids (TFAA) showed a progressive rise from harvest to senescence in all the flower tissues of cut rose cv Raktagandha (Table 2). Irrespective of micronutrient treatments TFAA content in corolla was highest, followed by that of leaf and stem in all the stages of flower senescence. Lowest TFAA in the tissues of corolla and leaf at all the stages of senescence, and in stem on 3rd day in the vase, however, moderately low TFAA in stem at harvest and on senescence was associated with $FeSO_4$ (2.0%) spray which recorded the longest vase life among all the micronutrient treatments. There is breakdown of proteins and release of free amino acids in the senescing petals of cut flowers. Senescence of cut roses is associated with an increase in most of the amino acids and concentration of TFAA (Gao

and Wu 1990) in petals. The lower content of TFFA in most of the flower tissues observed with $FeSO_4$ (2.0%) foliar spray indicated that breakown of proteins was less compared to control.

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