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Bionomics of Rose Aphids and their Natural Enemies

Muhammad Naeem[a]*, Abrar Ali Mohsan[a], Ata-ul-Mohsin[a] and Nadeem Akhtar Abbassi[b]

[a]Department of Entomology, PMAS- Arid Agriculture University, Rawalpindi, Pakistan

[b]Department of Horticulture,, PMAS- Arid Agriculture University, Rawalpindi, Pakistan

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Abstract. Aphids and their natural enemies were enumerated on 11 rose cultivars at weekly basis during the year 2005, at PMAS-Arid Agriculture University, Rawalpindi, Pakistan. Rose plants were found to be colonized by rose aphid (*Macrosiphum pachysiphon),* potato aphid *(Macrosiphum euphorbiae, Rhodobium porosum),* 7-spotted lady bird beetle *(Coccinella septempunctata),* syrphid fly *(Episyrphis balteatus)* and *Aphidius rosae*. Significantly, greater aphid populations were observed on the cultivar Blumonia than on other varieties. Higher percentage of parasitism and predation were observed on the cultivars, Good News and Golden Master, respectively.

Keywords: bionomics, rose aphids, predators, parasitoids, rose cultivars

Introduction

Roses *(Rosa indica* Linn.) are popular in landscaping but are attacked by several insect pests, including rose aphids and the large rose sawfly. Aphids can cause defoliation of the plant and deformation of buds if populations are left unchecked (Becker, 1997). Rose aphids *Macrosiphum rosae* L. and *Macrosiphum rosaeformis*, potato aphid *Macrosiphum euphorbiae* (Thomas), cotton aphid *Aphis gossypii* are serious pests of rose plants. Thirty-one species of aphids were reported on *Rosa* species (Blackman and Eastop, 1984). Aphids reproduce either sexually or parthenogenetically (Becker, 1997).

Both biotic and abiotic factors have the potential to influence the aphid population dynamics (Caralyn and Hunter, 2007). Predators including several species of coccinellids and syrphid flies as pest control agents are of interest in conservation and biological control (Symondson *et al.*, 2002). Coccinellid beetles are important predators that contribute to pest suppression in the agricultural landscape (Gardiner *et al*., 2009). The bushes of *Rosa rugosa* (Thunb.) are a reservoir of aphid predators and parasitoids and rose bush flowers provide a source of nectar and pollen (Frere *et al.*, 2007).

Recent studies have suggested that parasitoid wasps Braconidae (Aphidiinae and Aphelinidae) contribute more to the natural control of aphid than was previously thought (Schmidt *et al.*, 2003). The ladybird beetle *(Coccinella septempunctata* L.) can consume approximately 200 aphids in a day. Both larvae and adult of the beetle are ferocious predators of aphids (McBride and Glogozo, 1993). The larval voracity of *C. septumpunctata* was 518 aphids per larva (Devjani and Singh, 2006). The syrphid fly or hover fly larva (Diptera: Syrphidae) can eat up to 1200 aphids during its development. Hover fly, *Episyrphis balteatus*, is an abundant and efficient aphid predator (Almohamed *et al.*, 2007).

The objective of the study described here was to quantify the population dynamics of aphids and their natural enemies on rose cultivars in relation to environmental factors.

Materials and Methods

Aphid populations and those of their natural enemies were counted on rose varieties during the year 2005. Eleven rose cultivars were selected in three replications. Following randomized complete block design (RCBD), three plants from each cultivar were marked as replication and tagged individually as Golden Master, Diamond, Good News, Pink Beauty, Elizabeth of Giammer, Surkha Rose, Pink (Victoria), Yellow (Golden Shower), Red (Queen Elizabeth), White (Iceland) and Blumonia. Each plant was divided into upper, middle and lower part and each part was further divided into stem, leaves and buds for taking population samples. These plants were tagged to count the population of aphids and their natural enemies.

Data collection was started at the beginning of aphid immigration to roses in the month of March and counts were made weekly until the collapse of aphid population and their natural enemies. Meteorological data (temperature, humidity and rainfall) were obtained from the Regional Agro-Meteorological Centre, Rawalpindi. Population changes in predators and parasites in relation to aphid population were also recorded. Aphids and their natural enemies from stems, leaves and buds were

*Author for correspondence; E-mail: naeem18ap@yahoo.com.uk

collected and preserved in 75% alcohol in glass vials for later identification. The collected specimens were identified to species following Eastop (1961), Martin (1993), Stroyan (1977) and Blackman and Eastop (1984), with the aid of an Olympus binocular microscope. Descriptive statistical analysis was carried out using Minitab, and analysis of variance among treatments, using Statistical Package for Social Studies (SPSS).

Results and Discussion

Insects on rose plants. Rose plants were observed to be colonized by *Macrosiphum pachysiphon, Macrosiphum euphorbiae, Rhodobium porosum*, 7-spotted lady bird beetle *Coccinella septempunctata* L., *Aphidius rosae* Haliday, hover fly *Episyrphus balteatus* Deg. and a total of 35,863 insects were recorded in 2005. Life stages of the aphids and their percentage composition are shown in Table 1 and 2 and the number of aphids, *M. euphorbiae, M. pachysiphon* and *R. porosum* on individual rose cultivars associated with environmental factors, in Table 3.

Golden Master. Total insects on cultivar Goden Master were 1288, and the aphid count was 1278. Among natural enemies were 9 LBB, 1 aphid mummy but no syrphid fly was found. Predation and parasitism rates were 0.704%, 0.078%, respectively.

The population of rose aphids started building up in the month of March, peaked in April (17th week) and continued until it declined to zero (Fig.1a). Statistical analysis showed that there were significant effects between replicate [$F_{(2,47)}$ = 3.459, P<0.044] and within weekly [$F_{(15,47)}$=2.645, P< 0.011].

Diamond. Total number of insects present on the variety Diamond was 1592, while no natural enemies were found.

Table 1. Morphs of aphids (%) recorded on different rose cultivars

Cultivars	Nymph	Adult	Alate
Golden Master	78.16	20.73	1.09
Diamond	77.70	21.76	1.13
Good News	70.71	28.06	1.22
Pink Beauty	75.62	23.41	0.95
Elizabeth of Giammer	69.93	28.85	1.21
Surkha Rose	73.09	25.20	1.70
Pink (Victoria)	76.81	22.14	1.03
Yellow (Golden Shower)	75.07	24.37	0.55
Red (Queen Elizabeth)	73.33	25.66	1.00
White (Iceland)	72.15	26.67	1.17
Blumonia	75.55	23.49	0.95

Table 2. Percentage of total aphids collected in glass vials on different rose cultivars

Varieties	*M.euphorbiae*	*M.pachysiphon*	*R. porosum*
Golden Master	17.76	79.91	2.86
Diamond	29.74	67.08	3.16
Good News	6.04	91.56	2.40
Pink Beauty	18.55	80.54	0.90
Elizabeth of Giammer	15.89	82.78	1.32
Surkha Rose	30.52	66.84	2.63
Pink (Victoria)	17.76	72.08	10.15
Yellow (Golden Shower)	11.50	81.00	7.50
Red (Queen Elizabeth)	33.87	66.13	0
White (Iceland)	21.63	77.40	0.96
Blumonia	17.77	78.51	3.70

The population of rose aphids started building up in the month of March and peaked in May (19th week) (Fig .1b). There were no significant effects observed in replicate [$F_{(2,47)}$ = 2.176, P<0.131] and significant in weekly [$F_{(15,47)}$ = 3.341, P<0.002].

Good News. A total of 905 insects were recorded on the variety Good News while the aphids counted by visual survey were 898. Among natural enemies, 4 LBB and 3 aphid mummies were found but no syrphid fly. Predation and parasitism rates were 0.444%, 0.333%, respectively.

The population of rose aphids started building up in the month of March and peaked in May (19th week) (Fig.1c). There were no significant effects observed between replicate [$F_{(2, 47)}$ = 2.775, P<0.078] and significant within weekly [$F_{(15,47)}$ = 4.190, P<0.000].

Pink Beauty. Total number of insects present on Pink Beauty was 1681, but the aphids counted by the visual survey numbered 1674. Among natural enemies 2 LBB and 5 aphid mummies were found but no syrphid fly. Predation and parasitism rates were 0.119 %, 0.298 %, respectively.

The population of rose aphids starts building up in the month of March and peaked in April (17th week) (Fig.1d). There were significant effects observed between replicate [$F_{(2, 47)}$ = 5.912, P<0.006] and within weekly [$F_{(15, 47)}$ = 2.165, P<0.034].

Elizabeth of Giammer. The insects present on this cultivar numbered 2146, while the aphids counted by visual survey numbered 2142. Among natural enemies were 4 LBB and aphid

Table 3. Mean number of aphids on rose cultivars (mean/plant ± S.E.) in relation to temperature, relative humidity and rainfall during 2005

Date	Week	Aphid number (Mean/plant±S.E.)	Mean Temp °C (weekly)	Relative humidity	Rainfall (mm)
12-03-05	11	23.74 ± 13.45	16.83	62.42	0.02
19-03-05	12	70.62 ± 31.04	17.43	80.28	5.15
26-03-05	13	44.62 ± 15.65	15.91	77.57	3.87
02-04-05	14	31.80 ± 15.37	18.27	54.5	1.81
09-04-05	15	78.90 ± 29.81	21.32	42.94	0
16-04-05	16	73.06 ± 24.46	17.87	48.00	0.28
23-04-05	17	167.24 ± 55.68	24.26	41.00	0
30-04-05	18	115.07 ± 34.67	21.04	58.86	2.31
07-05-05	19	147.17 ± 44.98	32.39	60.66	2.12
14-05-05	20	102.41 ± 45.11	24.07	37.71	0
21-05-05	21	189.62 ± 61.72	26.77	35.64	0.51
28-05-05	22	112.28 ± 38.73	25.55	32.36	0.05
04-06-05	23	162.88 ± 64.28	28.04	31.07	11.5
11-06-05	24	37.64 ± 15.69	29.95	45.07	1.11
18-06-05	25	4.36 ± 2.37	30.74	32.21	0
25-06-05	26	12.89 ± 3.93	34.28	31.64	0

mummies but no syrphid flies. Predation rate was 0.187%. The population of rose aphids started building up in the month of March and peaked in March (12th week) (Fig.1e). Statistical analysis shows that there were no significant effects between replicate [$F_{(2, 47)}$ = 2.476, P<0.101] and significant within weekly [$F_{(15,47)}$ = 7.309, P<0.000].

Surkha Rose. Total number of insects found on cultivar Surkha Rose was 4006, while the number of aphids counted by visual survey was 3988. Among natural enemies were 10 LBB, 5 aphid mummies and 3 syrphid flies. Predation and parasitism rate were 0.326 %, 0.125%, respectively. The population of rose aphids started building up in the month of March and peaked in May (19th week) (Fig. l f). No significant effects were observed between replicate [$F_{(2, 47)}$ =0.985] and significant within weekly [$F_{(15,47)}$ = 4.947, P<0.000].

Pink (Victoria). A total of 2719 insects were counted on Pink (Victoria) of which the aphids were 2709. Among natural enemies, 5 ladybird beetles, 4 aphid mummies and 1 syrphid fly were found. Predation and parasitism rate were 0.221 %, 0.147%, respectively.

The population of rose aphids started building up in the month of March and peaked in April (15th week) (Fig. 1g). No significant effects were observed between replicate [$F_{(2, 47)}$ = 2.682, P<0.084] and significant within weekly [$F_{(15, 47)}$ = 7.878, P<0.000].

Yellow (Golden Shower). A total of 2733 insects were recorded, on variety Yellow (Golden Shower) of which the aphids were 2720. Among natural enemies 7 LBB, 5 aphid mummies and 1 syrphid fly were counted. Predation and parasitism rates were 0.294%, 0.183%, respectively. The population of rose aphids started building up in the month of March and peaked in May (18th week) (Fig.1h). Statistical analysis revealed significant effects between replicate [$F_{(2, 47)}$ = 5.272, P<0.010] and within weekly [$F_{(15,47)}$ = 4.360, P< 0.000].

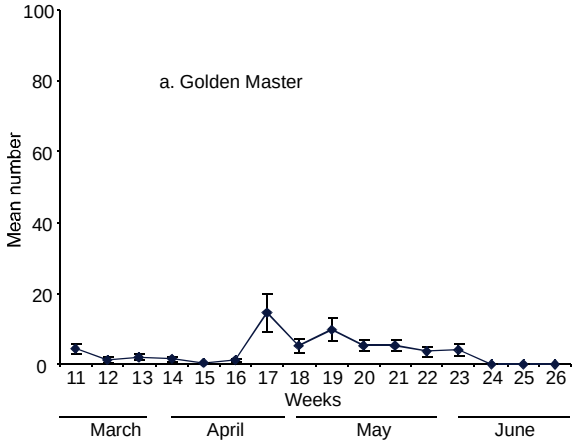

Fig. 1a. Number of rose aphids (mean/plant ±SE) recorded on Golden Master in relation to time period during 2005.

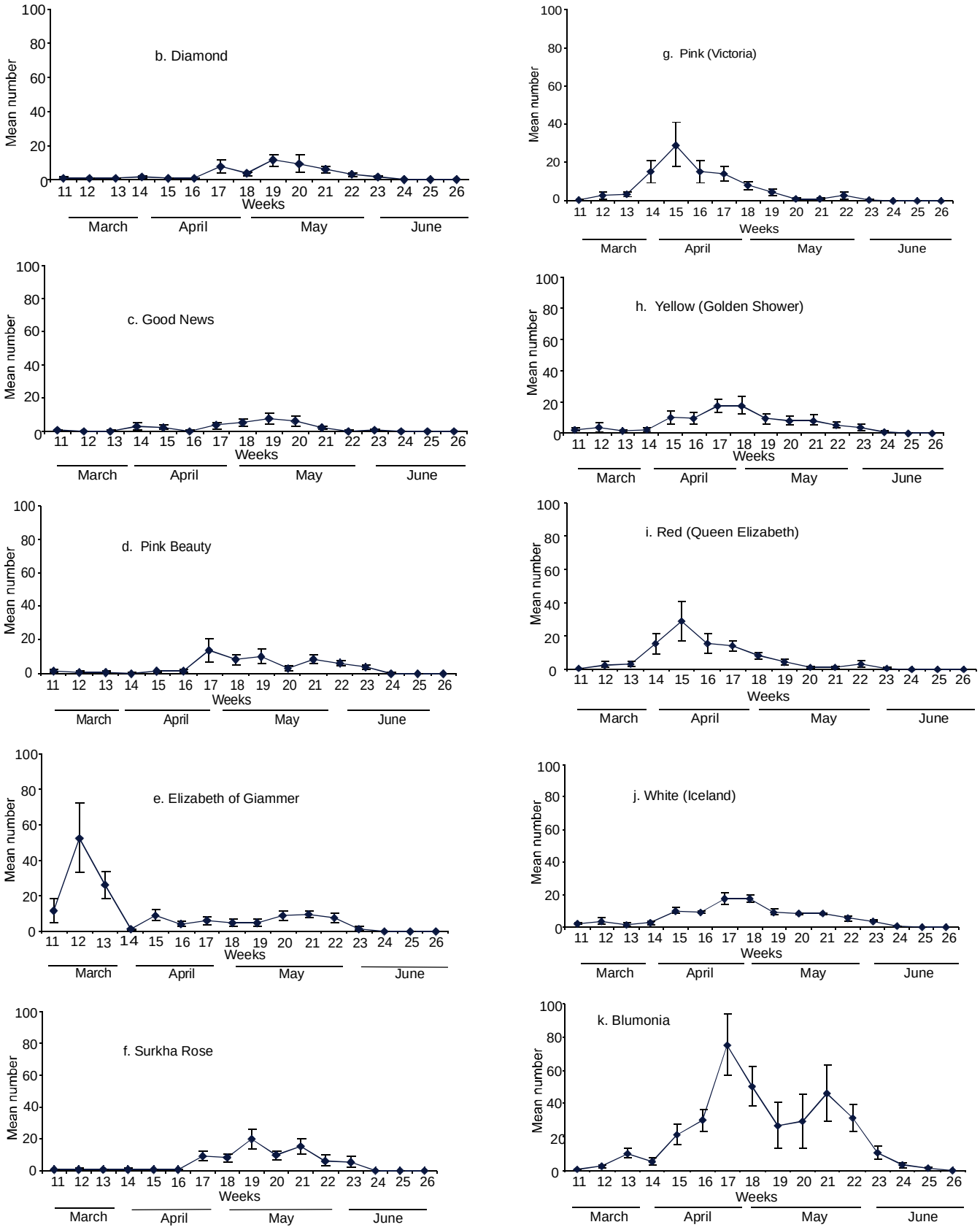

Fig. 1(b-k). Number of rose aphids (mean/plant ± S.E.) recorded on the rose cultivars in relation to time period during 2005.

Red (Queen Elizabeth). Total number of insects found on cultivar Red (Queen Elizabeth) was 3896, including 3881 aphids. Among natural enemies 8 LBB, 4 aphid mummies and 3 syrphid flies were found. Predation and parasitism rate were 0.283 %, 0.103 %, respectively.

The population of rose aphids started building up in the month of March and peaked in April (15th week) (Fig. l i). Statistical analysis showed that there were no significant effects between replicate [$F_{(2, 47)} = 2.681$, $P<0.0841$] and significant within weekly [$F_{(15,47)} = 7.877$, $P<0.000$].

White (Iceland). The insects present on cultivar White (Iceland) numbered 5543, including 5523 aphids. Among natural enemies, 16 LBB, 2 aphid mummies and 2 syrphid flies were present. Predation and parasitism rates were 0.326% and 0.036%, respectively.

The population of rose aphids started building up in the month of March and peaked in May (18th week) (Fig. 1j). Statistically there were no significant effects between replicate [$F_{(2, 47)} = 5.239$, $P < 0.011$] and significant within weekly [$F_{(15,47)} = 4.359$, $P< 0.000$].

Blumonia. A total of 9354 insects were counted on Blumonia, of which the aphids were 9339. Among natural enemies 9 LBB, 5 aphid mummies and 1 syrphid fly were found. Predation and parasitism rates were 0.108% and 0.054%, respectively.

The population of rose aphids started building up in the month of March and peaked in April (17th week) (Fig. lk). Statistical analysis revealed significant effects between replicate [$F_{(2, 47)}$ = I 9.328, $P< 0.000$] and within weekly [$F_{(15,47)} = 4.786$, $P< 0.000$].

In general, aphid populations started to increase in early March and peaked in all cultivars in mid April to mid May (15 to 19 weeks), except Elizabeth of Giammer, followed by a rapid reduction in the number of individuals) (Fig. 1a-k). Hamid (1984) observed that the peak population of aphid was in the month of March and the rise and decline was due to different environmental factors, temperature and rainfall. Shower of rainfall reduced the population of aphids (Rustmani *et al.*, 1999). Naeem and Compton (2000) reported that fluctuations in population build-up of aphids were influenced by rainfall also. In the present studies the rise in population was due to prevailing favourable conditions of food, moisture and low temperature. Observation of food availability and the environmental factors, especially temperature and humidity, are important in this regard (Jones and Jones, 1984). There are several factors, which affect rapid increase and decrease of aphid population. Both physical and biological factors are potentially important in the variation of aphid population density (Naeem, 1996). Aphids gradually decline in number then disappear mostly by late May or early June, at least partly, in response to warmer temperature (Milles, 1985; Maelzer, 1977). The increase in temperature and rainfall is the main factor affecting aphid population (Jaskiewicz, 2003). The environment, wherein organisms live, inevitably affects all of its vital functions (Estay *et. al.* 2009). Weather conditions alter the activity and reproduction of aphids (Chambers *et al.*, 1986). Temperature is considered to be very important among environmental factors influencing aphid populations. In the present study, high polulation of rose aphids was observed on Blumonia as compared to all other cultivars under study (Fig.2). The significant result shows that Blumonia is more susceptible. The percentage predation was lower in rose varieties, although no significant effects were found. Natural enemies including coccinellid beetles, syrphid flies and hymenopterous parasitoids are considered to be responsible for preventing the out break (Chambers and Sunderland, 1983). A group of factors mainly high temperature, low relative humidity, action of parasites and predators, crop maturity and rainfall contributed to vanishing of aphid population (Singh and Singh, 1989; Roy, 1975). Results of present studies depict that the environmental factors have relatively more impact on reducing aphid densities than the biological control agents on the rose cultivars under study.

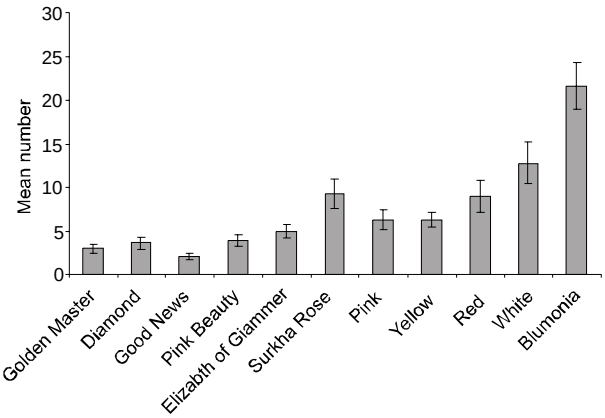

Fig. 2. Rose aphids (mean/plant ± S.E.) observed on rose cultivars by direct sampling method.

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