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The Presence and Distribution of the Red Palm Mite, *Raoiella indica* Hirst (Acari: Tenuipalpidae) in Trinidad

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ABSTRACT.
The red palm mite, *Raoiella indica* Hirst (Acari: Tenuipalpidae) is an Invasive Alien Species (IAS), which was first detected in the Western Hemisphere in the island of Martinique in 2004. It has since spread to Dominica (2005), Dominican Republic (2006), Puerto Rico (2006), Trinidad (2006), St. Vincent (2007), Jamaica (2007), and Grenada (2007). The pest has the potential to quickly spread to new locations by wind currents or human activities. Raoiella indica was first detected in Trinidad in March 2006. Surveillance activities revealed that the pest was rapidly dispersing to new areas. From July-September 2007, a survey was conducted to detect the presence and distribution of red palm mite and native natural enemies in Trinidad. Ten coconut farms were randomly selected from each of the eight counties and two trees were sampled from each farm. In each case, samples were collected from the 3rd and 9th fronds and examined in the laboratory for red palm mite and natural enemies. The data were analyzed using the Statistical Package for Social Science (SPSS), Version 7.5. Red palm mite was present in all counties, but the numbers observed in each county were varied. Nariva/Mayaro and St. Andrew/St. David had significantly ($p<0.05$) more mites than the other counties. The predominant natural enemy was Amblyseius largoensis (Acari: Phytoseiidae); however, predatory mite populations were low ranging from only nine in theSt. Patrick East samples to 81 in St. George West. Counties with higher populations were those with large coconut farms >20.0 hectares. Because the red palm mite was found to be widespread, surveys should also be conducted in the dry season and long term population dynamics studies should be initiated. Amblyseius largoensis should be reared and mass produced in the laboratory for augmenting field populations,and classical biological control also should be investigated to manage the pest.

KEYWORDS: *Raoiella indica*, natural enemy, Trinidad

INTRODUCTION

Red palm mite *Raoiella indica* Hirst (Acari: Tenuipalpidae) is an important pest of coconuts (*Cocos nucifera* L.*)* and areca palm (*Areca catechu* L.) in India, Pakistan and Mauritius. It is also present in Iran, Egypt, Israel, Sudan, Russia, Oman United Arab Emirates, Sri Lanka, Philippines and Reunion. In the Western Hemisphere, *R. indica* was first observed in Martinique in 2004. It has now spread to St. Lucia (2005), Dominica (2005) and Dominican Republic (2006) (Kane et al., 2006). *R. indica* also was detected in Puerto Rico in 2006 (Calero-Toledo et al., 2006). In 2007, it was reported from St. Vincent, Jamaica and Grenada. Other countries affected in the region are Guadeloupe, Haiti, US Virgin Islands and USA (Florida).

*Raoiella indica*is of Asian origin. It was described by Hirst in 1924 from coconut leaves in Coimbatore, India (Flechtmann and Etienne, 2004). All stages, including eggs, are red in color; however, adult females can be easily distinguished by the presence of black patches on their backs. *R. indica* has long spatulate setae and flattened bodies in comparison to spider mites (Tetranychidae) (Kane and Ochoa, 2006).

The Presence of *R. indica* in Trinidad

In March 2006, *R. indica* was first detected at San Quintin Estate, Icacos in the southwestern peninsula of Trinidad. Samples of pinnae of coconut palm fronds taken to the Entomology laboratory were preliminarily diagnosed to be infested with *R. indica.* Specimens were later confirmed to be this species by Dr. Ronald Ochoa of the Insect and Mite Identification Service of the USDA-ARS Systematic Entomology Laboratory. This service was facilitated through CARINET.

In May 2006, a rapid reconnaissance program undertaken by the Ministry of Agriculture, Land and Marine Resources (MALMR) and assisted by the USDA officials (Dr. Ronald Ochoa and Ethan Kane) confirmed the presence of red palm mite found in coconuts (*C. nucifera*), indigenous heliconias (*Heliconia* spp.) and bananas (*Musa* spp.) at Icacos and Guayaguayare. Subsequent surveillance activities showed that the red palm mite was rapidly spreading to new locations.

Economic Impact of *R. indica*

Raoiella indica is a pest of quarantine importance. Its presence could have a negative impact on international trade as restrictions have already been implemented by USDA to reduce the risk of entry of red palm mite into the United States. The pest was first detected in Florida in December 2007.

Raoiella indica has the potential to quickly establish and spread to new areas. It can be dispersed by wind currents and also through trade (Welbourn, 2006) and human activities (Mendonca *et al.*, 2005), which may have been the pathway of entry into this country. The pest has a high reproductive rate with a life cycle of 33 days and it can reproduce both by sexual and parthenogenetic means (Mendonca *et al.*, 2005). Although the red palm mite predominantly attacks palms (Arecaceae) (Kane *et al.*, 2006), it also has been reported from a number of host plants in six other families.

Natural/Biological control of *R. indica*

In many countries where red palm mite is present, natural regulation often occurs. Nageshachandra and Channabasavanna (1984) reported an increase in population levels of red palm mite during periods of low relative humidity, high temperatures and long periods of sunlight, whereas high rainfall had a negative impact. In Mauritius, the predatory mite, *Typhlodromus caudatus* Berlese (Acari: Phytoseiidae) was reported to be an important natural enemy of eggs of *R. indica* (Moutia, 1958). In Trinidad, several natural enemies have been observed in association with red palm mite.

Objectives of the study

Investigations on *R. indica*, its host range, distribution, biotic and abiotic factors affecting populations in Trinidad would form the basis for adoption of management strategies for the pest.

This study was conducted to confirm the presence and distribution of *R. indica* in Trinidad. It is also expected to identify associated natural enemies and their distribution.

MATERIALS AND METHODS

Site/tree Selection

A list of coconut farms was obtained from each of the eight County Agricultural Offices in Trinidad. From each county ten locations/farms were randomly selected. At each location/farm two trees were sampled.

Leaf Sampling

In each selected tree, the 3rd and 9th fronds were cut and gently lowered to the ground by the tree climber using a rope. Intotal, six leaflets were taken from each frond; one each, 60 cm from both the leaftip and leafbase and four from the intermediate portion of the leaf, i.e. two leaflets from both sides of the rachis. The samples were placed in plastic bags, labelled, stored in coolers and transported to the Entomology laboratory.

Laboratory Examination

Leaflets from each sample were passed through a mite-brushing machine. The mite-brushing machine sweeps mites and natural enemies off the leaflets into a spinning disc which is divided into twelve sections from the center radiating towards the circumference. Direct visual counts of mites and natural enemies were made on the disc under a binocular stereo microscope at a magnification of150 x.

Data Collection

Data on variety of coconut (tall, short, yellow, green), height of tree and location using the Global Positioning System (GPS) were recorded n the Field Data Sheet (Appendix 1.)

The number of leaflets examined, number of red palm mites and the number of natural enemies were recorded in the Laboratory Data Sheet (Appendix II).

Data Analysis

The data were analysed using the Statistical Package for Social Sciences (SPSS) Version 7.5. Because the data were not normally distributed, they were also logarithm transformed and subjected to analysis of variance (ANOVA).

RESULTS AND DISCUSSION

The number of coconut farms by county is shown in Figure 1. The majority (71.9%) of coconut farms in all counties except Nariva/Mayaro were small scale/backyard situations less than 1 hectare in size. Medium sized farms (> 1.0 ha –20.0 ha) were located in all counties comprising (26.2 %) of the total number while large farms (>20.0 ha) comprised 1.9%. The eight large farms were located in the counties St. Andrew/St. David, St. Patrick West and Nariva/Mayaro. (Table1). The distribution of small, medium and large coconuts farms is given in Figure 2.

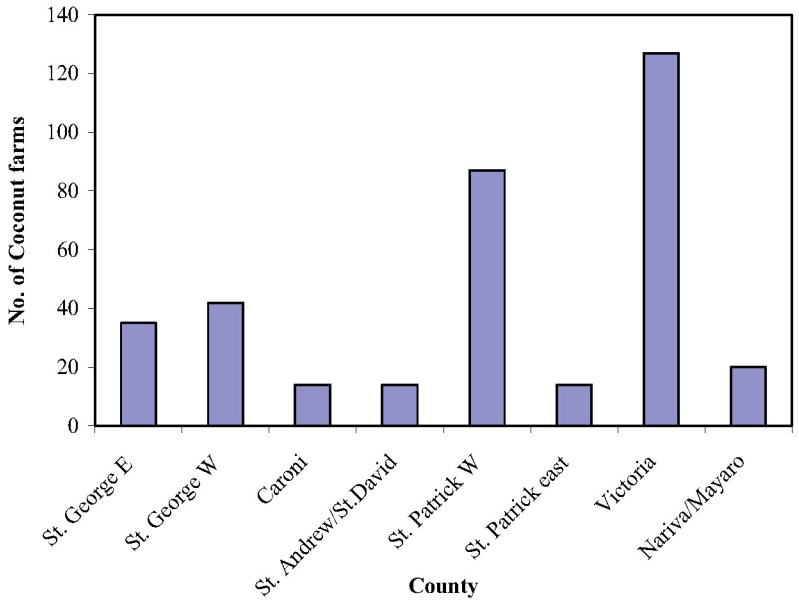

Figure 1. Distribution of coconut farms by county

Source: County Agricultural Offices

Overall, red palm mite was present in all counties (Appendix III). In most situations were red palm mite was found natural enemies also were present. Natural enemies consisted of two species of predatory mites in the families Phytoseiidae and Cunaxidae and lacewings (Chrysopidae). In general, natural enemy populations were low for all counties (Figure 3) ranging from nine in St. Patrick East to 81 in St. George West.

Table 1. The distribution of coconut farms by size of holdings for all counties

County	Small farms < 1.0 ha	Medium farms > 1.0 to < 20 ha.	Large farms > 20 ha	Total no. of farms
St. George East	35	1	0	36
St. George West	41	1	0	42
Caroni	12	2	0	14
St. Andrew/St. David	9	4	1	14
St. George East	13	1	0	14
St. George West	72	11	4	87
Victoria	112	6	0	172
Nariva/Mayaro	0	27	3	30
Total	294	107	8	409
%	71.9	26.2	1.9	100

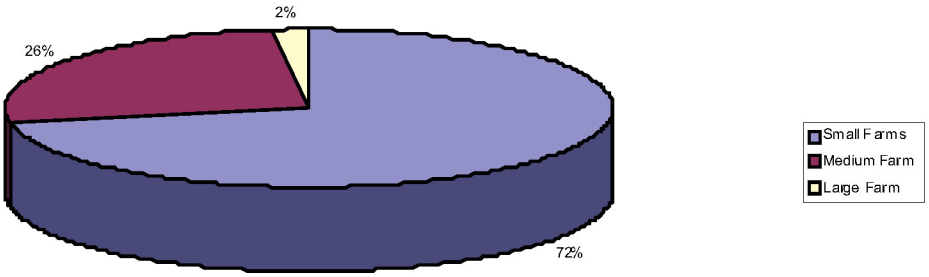

Figure 2. The Distribution of Small, Medium and Large coconut farms in Trinidad

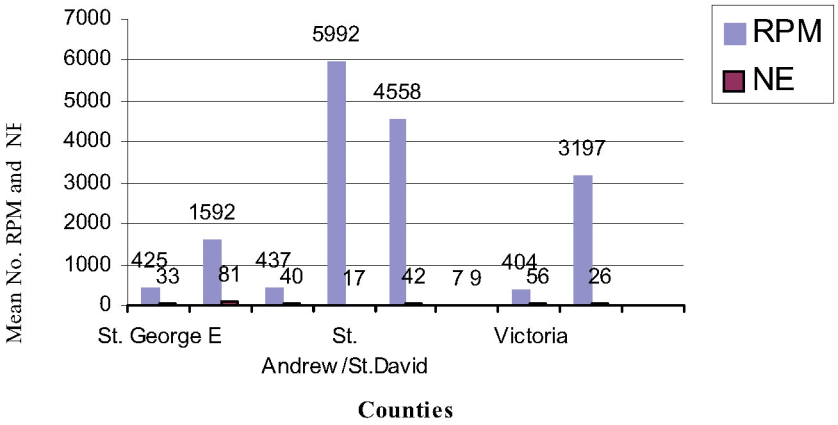

Figure 3. The Mean No. of Red Palm Mite(RPM) and Natural Enemies (NE) by County

Table 2. The mean number (log transformed) of red palm mite on leaf 3 by county [1]

County	Mean	Std. Error
St. George East	3.468	.767
St. George West	4.419	.548
Caroni	3.316	.525
St. Patrick West	4.802	.500
St. Andrew/ St. David	6.388[a]	.533
St. Patrick East	.169	.548
Nariva / Mayaro	6.629[a]	.641
Victoria	3.350	.467

1 Means within the column followed by similar letter do not differ significantly ($p<0.05$)

Table 3. The mean No. of red palm mite by month for leaf 3[1]

Month	Mean	Std. Error
7	4.316 [a]	.311
8	4.560 [a]	.337
9	4.235 [a]	.421

1 Means within the column followed by similar letter do not differ significantly ($p<0.05$)

Table 4. The mean number (log transformed) of red palm mites on leaf 9 by counties[1]

County	Mean	Std. Error
St. George East	3.918	.820
St. George West	5.476	.587
Caroni	2.879	.562
St. Patrick West	4.929	.535
St. Andrew / St. David	6.655 [a]	.570
St. Patrick East	.949	.587
Nariva / Mayaro	6.835 [a]	.685
Victoria	3.201	.500

1 Means within the column followed by similar letter do not differ significantly ($p<0.05$)

Table 5. The mean No. of RPM for leaf 9 by month[1]

Month	Mean	Std. Error
7	4.823 [a]	.333
8	4.705 [a]	.360
9	4.257 [a]	.451

1 Means within the column followed by similar letter do not differ significantly ($p<0.05$)

Table 6. The mean number (log transformed) of natural enemy by county[1]

County	Mean	Std. Error
St. George East	3.655 [a]	.420
St. George West	4.159 [a]	.301
Caroni	3.245	.288
St. Patrick West	3.428	.274
St. Andrew/ St. David	1.963	.292
St. Patrick East	1.539	.301
Nariva / Mayaro	3.482	.351
Victoria	3.640 [a]	.256

1 Means within the column followed by similar letter do not differ significantly ($p<0.05$)

Table 7. The mean number (log transformed) of natural enemy by month[1]

Month	Mean	Std. Error
7	3.472 [a]	.171
8	2.521	.185
9	3.144 [a]	.231

1 Means within the column followed by similar letter do not differ significantly ($p<0.05$)

The mean number of red palm mite and natural enemy by county and month is summarized in Tables 2-7 respectively.

The ANOVA showed highly significant ($p<0.000$) county and month effects for mite and natural enemy populations on both leaf 3 and leaf 9. These effects also were noted in surveys conducted in St. Lucia where differences in mite populations were found between regions and months (Bruce Lauckner, palmmite@cardi.org).

Population Dynamics

For both leaves 3 and 9, the county Nariva/ Mayaro had significantly ($p<0.05$) more mites than the other counties except St. Andrew/St. David. Nariva/Mayaro had the highest number of mites followed by St. Andrew/St. David, St. Patrick West, St. George West, St. George East, Victoria, Caroni and St. Patrick East for leaf 3. The counties with higher mite populations also were those with large (>20.0ha) coconut farms except for St. George West, which is densely populated (people) and has numerous backyard situations with trees clustered together like large estates. In most situations, Leaf 9 had more mites than Leaf 3, which is expected because symptoms of mite infestations are always more pronounced on the lower leaves.

On large farms, once the infestation occurs it is expected that populations would increase exponentially given the high reproductive rate and potential to quickly establish and disperse to new locations (Mendonca et al, 2005). In May 2006, surveillance activities revealed no evidence of red palm mite in St. Andrew/St. David however high populations were observed further south in Nariva/Mayaro at Guayaguayare. By September 2006, red palm mite was first observed at Manzanilla in St. Andrew/St. David and at the time of the survey, one year after, the population had exploded. This quick spread and establishment to Andrew/St. David may be attributed to wind movements and commerce in green coconuts because workers/ coconut vendors move from area to area in search of green/immature coconuts transporting with them infested leaves as packing

material. The high populations of red palm mite in St. Andrew/St. David is not unexpected since this county had large numbers of available host and one of the lowest number of natural enemies. In the absence of density dependent factors, e.g. predators, there is exponential growth of a (pest) population in newly infested areas. However, exponential growth of a population is followed by large fluctuations (Murray, 1979). Welbourn (2006) reported that red palm mite can be dispersed by wind currents and through trade whereasMendonca et al, (2005) indicated that dispersal is also through human activity where people contribute to infestation. St. Patrick East had few (14) coconut farms, the majority of which were backyard situations sparsely distributed which may attribute to low red palm mite populations as compared to St. George West, which has many backyard farms forming clusters of coconut trees.

Regarding natural enemies, several predators were found associated with red palm mite in the field. These include *Amblyseius largoensis* Muma, an unidentified species in the family Cunaxidae, ladybird beetles (Coccinellidae) and lacewings (Chrysopidae). The predominant one was *A. largoensis*. The population was significantly ($p < 0.05$) greater in St. George West than in St. Andrew/St. David, St. Patrick East, Nariva/Mayaro, Caroni and St. Patrick West. Although they were present in all counties there was no correlation between the natural enemy complex and red palm mite populations. However, indigenous natural enemies found attacking red palm mite are expected to provide some control of the pest. At present, there seems to be very little or no impact on the pest populations. According to Cornell and Hawkins (1993), indigenous natural enemy complexes on exotic species…"are too young to be considered fully integrated associations" as compared to indigenous species and … "may require between 100 – 10, 000 years." Therefore intervention is required by way of rearing and multiplication of natural enemies to augment the natural enemy population or the implementation of a classical biological control strategy to manage the pest.

Varietal Influence

The varieties surveyed were dwarf green, dwarf yellow, tall green and tall yellow. Since a varietal effect was not observed it suggests that all varieties are susceptible. However, dwarf green coconuts at Constance Estate, Icacos observed during routine surveillance, although highly infested displayed little or no typical symptoms of red palm mite infestation. A varietal effect observed in St. Lucia suggests that varieties displaying only minor symptoms of mite damage actually were highly infested, which may indicate varietal tolerance (Bruce Lauckner, palmmite@cardi.org)

Weather Influence

Regarding time of the year, the survey was conducted from July to September 2007 during the rainy season. Although a temporal effect was observed and populations of red palm mite were highest for leaves 3 and 9 in August and July, respectively, and natural enemy populations were significantly ($p < 0.05$) greater in July than in August, it is too early to suggest seasonal influence. However, it is expected that populations would peak and fluctuate from time to time as weather has an impact on red palm mite populations (Moutia, 1958., Nageshachandra and Channabasavanna, 1984). This phenomenon can be investigated by conducting long-term population dynamics studies and surveys during the dry season.

CONCLUSION

Red palm mite is distributed in all counties in Trinidad (Appendix III). Although the population is low in St. Patrick East, it is expected to increase with time. Natural enemies were also present in all counties surveyed, which suggests that they have an active role in regulating red palm mite populations. The presence of red palm mite is now widespread and confirmed to be in Trinidad.

RECOMMENDATIONS

Based on the high populations of red palm mite in St. Patrick West, St. Andrew/St. David and Nariva/Mayaro, it is recommended that long-term population dynamics studies of red palm mite and their natural enemies be conducted in these counties. Because the presence of natural enemies is expected to regulate red palm mite populations, these should be reared and mass produced in the laboratory for augmenting populations in the environment in a biological control program. Mite surveys also should be repeated during the dry season to investigate differences (if any) in populations due to abiotic factors. Finally, a survey should be conducted in Tobago to determine the status of red palm mite on the island.

REFERENCES

Calero-Toledo, L. M., Perez, J., Gil de Rubio, Y., Medina, R., Benitez, L., Guzman, B., Hewrnandez, R., Jimenez, S., Martinez, N., Millan, P., Romero, L., Rosario, N., Zaleski, C., Rodriguez, Cruz, B., Crespo C. and F. 2006. *Raoiella inidca* Hirst (Acari: Prostigmata: Tenuipalpidae) a new menace to *Musa* sp. Industry in Puerto Rico. USDA/APHIS/PPQ-PHIS San Juan.

Cornell, H. V. and Hawkins, B. A. 1993. Accommodation of native parasitoid species on introduced herbivores: a comparison of hosts as natives and hosts as invaders. Amer-Nat. (Chicago). 141: 847 – 865.

Flechtmann, C.H.W. and Etienne, J. 2004. The red palm mite, Raoiella indica Hirst, a threat to palms in the Americas. J. Systematic and Applied Acarology 9: 109-110.

Kane, E.C. and Ochoa, R. 2006. Detection and identification of red palm mite Raoiella indica Hirst (Acari Tenuipalpidae)

http.//www.sel.barc.usda.gov/acari/PDF/indica Guide.pdf

Kane, E. C., Ochoa, R., Mathurin, G. and Erbe, E.F 2006. Raoiella indica Hirst (Acari: Tenuipalpidae): An island hopping mite pest in the Caribbean. USDA-ARS, Baltimore.

Mendonca, R.S., Navia, D. and Flechtmann, C.H.W. 2005. Raoiella indicates Hirst (Acari: Prostigmata: Tenuipalpidae), O-mite vermelho das palms Uma ameaça for as Americas. Brasilia: Embrapa Genetic Resources and Biotechnology (Document 146). Available at:

http://www.cenargen.embrapa.br/publish/works/doc146.pdf

Moutia, L.A 1958. Contribution to the study of some phytophagous acarina and their predators in Mauritius. Bull. Ent. Res. 49 (1) 59-75.

Murray, Jr. B. G. 1979. Population Dynamics. Academic Press, INC. New York, 212 pp.

Nageshachandra, B. K. and Channabasavanna, G. P. 1984. Development and Ecology of Raoiella indica Hirst (Acari: Tenuipalpidae) on coconuts. In. Griffiths, D. A. and C. E. Bowman. Acarology Vl: 2, 785-798.

Welbourn, C. 2006. Red Palm Mite Raoiella indica (Acari: Tenuipalpidae). Pest Alert. DPI-FDACS; 4pp. (http://www.doacs.state. fl.us/pi/enpp/ento/r.indica.html).

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Appendix I

Appendix I

MINISTRY OF AGRICULTURE LAND AND MARINE RESOURCES

RED PALM MITE SURVEY - Field Data Sheet

Name of Officer: _____ **County:** _____

Date: _____ **Site Sampled:** _____

				GPS			
Tree	**Ref#**	**Variety**		**N**	**W**	**Altitude**	**Height**

Appendix II

Appendix II												
MINISTRY OF AGRICULTURE LAND AND MARINE RESOURCES												

RED PALM MITE SURVEY - Laboratory Data Sheet

Name of Officer: _____ **County:** _____

Date:_____ **Site Sampled:** _____

Ref.	**Variety**	**Leaf 3**				**Leaf 9**					**GPS**	
		No. of mites			**Leaflet**	**No. of mites**			**Leaflet**	**Natural**		
		E	**I**	**A**	**length (cm)**	**E**	**I**	**A**	**length (cm)**	**enemies**	**N**	**W**

Appendix III: Distribution of Red Palm Mite in Trinidad, July – September 2007

RED PALM MITE INFESTATION IN TRINIDAD

T. DAVID / ST. ANDREW	
LOCATION	INFESTATION
CUMANA	2
MATHURA	1
VALENCIA	3
PER MANZANILLA	2
PLUM RD.	2
ST. GEORGE EAST	
WALLERFIELD	2
ARIMA	3
MALONEY	5
ST. GEORGE WEST	
BAMBOO #1	5
LOPINOT	2
CAURA	1
DIEGO MARTIN	1
MARACAS	1
CARONI	
LAS LOMAS	1
ENTERPRISE	1
FREEPORT	2
CARAPICHAIMA	2
COUVA	1
PREYSAL	1
TORTUGA	1
MAMORAL	1

ST. PATRICK WEST		
CODE	LOCATION	INFESTATION
22	GRANVILLE	2
23	CEDROS	5
ST. PATRICK EAST		
24	SIPARIA	2
25	CLARKE ROCHARD	1
VICTORIA		
26	PRINCESS TOWN	5
27	NEW GRANT	1
28	CLAXTON BAY	1
29	MORUGA	2
30	BARRACKPORE	1
NARIVA / MAYARO		
31	TABAQUITE RD.	1
32	NAVET VILLAGE	1
33	LIBERTVILLE	2
34	LOWER MANZANILLA	1
35	MAYARO	1
36	GUAYGUAYARE	2
37	ORTOIRE VILLAGE	1