Table 4: Quality of Fruits of four cultivars on two rootstocks

Scions/ Rootstock	Fruit weight (g)	Fruit diameter (cm)	Rind thickness (mm)	Seeds (no)	Juice (%)	soluble solids (TSS) (%)	Acid (%)	TSS/Acid relations
Valencia								
Citrus amblycarpa	234,4	,5	4,6	1,8	47,4 b	10,00	0,87	11,5
Sour Orange	237,5	7,5	4,6	1,8	50,9 a	10,30	0,82	12,6
E.S.5,67 NS	0.08 NS	0,19 NS	0.7 NS	0,73 **	0,10 NS	0,22 NS	0,93 NS	
Marsh								
Citrus amblycarpa	381,9	9,3	8,4	4,0	39,5	8,90	1,45	6,18
Sour Orange	390,1	8,7	8,4	4,4	40,0	9,32	1,45	6,29
E.S.4,68 NS	1,98 NS	0,40 NS	0,16 NS	1,71 NS	0,30 NS	0,50 NS	0,09 NS	
Persian								
Citrus amblycarpa	96,3	5,2	1,9	0,0	41,1	10,28	6,56	-
Sour Orange	93,0	5,2	1,9	0,0	41,1	11,10	6,73	-
E.S.3,80 NS	0,30 NS	0,10 NS	-	1,28 NS	0,18 **	0,05 **	-	
Dancy								
Citrus amblycarpa	112,5	5,9	3,0	12,2	42,5	9,62	1,01	10,65
Sour Orange	109,3	5,8	3,0	12,1	41,7	9,95	1,05	10,23
E.S.2,20 NS	1,10 NS	0,10 NS	0,25 NS	0,40 NS	0,09 **	0,02 NS	0,48 NS	

NS = not significant ; ** = significant at 5%

Table 5: Percentage of dead trees caused by Gummosis and blight on four cultivars on two rootstock during a 10 year period.

	Valencia		Marsh		Persian		Dancy	
Rootstock	Blight	Gummosis	Blight	Gummosis	Blight	Gummosis	Blight	Gummosis
C. amblycarpa	0	20	0	0	0	0	0	0
Sour Orange	0	0	0	0	0	0	0	0

THE EFFECT OF *CRYPTOLAEMUS MONTROUZIERI* (MULSANT) ON THE HIBISCUS MEALYBUG *MACONELLICOCCUS HIRSUTUS* (GREEN), ON HIBISCUS PLANTS IN TRINIDAD

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La présence de la cochenille de l'Hibiscus (HMB), *Maconellicoccus hirsutus* (verte), a été enregistreé pour la premiére fois à Trinidad en Juin 1995. Le contrôle chimique et cultural mis en oeuvre pour limiter à court terme l'extension de la cochenille a été inefficient. En l'absence d'un contrôle efficace, de nombreuses plantes, appartenant notamment à la famille des Malvaceae, ont succombé à l'attaque de la cochenille. Une stratégie de gestion intégrée (IPM) a été proposée pour contrôler l'insecte sur le long terme, basée principalement sur un contrôle biologique classique. La coccinelle *Cryptolaemus montrouzieri* (CM) (Coléoptére : Coccinellidae), prédatrice de la cochenille a été introduite à Trinidad en provenance d'Inde en Février 1996. Les résultats préliminaires de cette étude sur les effets de *Cryptolaemus montrouzieri* sur *Maconellicoccus hirsutus* dans les Caraïbes,décrivent et quantifient la situation actuelle sur le terrain, en relation avec les dynamiques de la cochenille et de son prédateur. Les résultats montrent que CM a été efficace en réduisant progressivement la population de HMB sur un certaine période de temps. Ces résultats informent et guident les recherches futures et les prises de décision à propos de l'utilisation de *Cryptolaemus montrouzieri* comme prédateur pour contrôler les attaques potentiellement dévastatrices de *Maconellicoccus hirsutus*.

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La cochinilla rosada *Maconellicoccus hirsutus* (MH) de las plantas de *Hibiscus sp* fue reportada por primera vez en Trinidad en Junio de 1995. Los controles químicos y culturales que se usaron para controlarla en un período corto fueron inefectivos. En ausencia de un control efectivo, muchas plantas, particularmente miembros de la familia *Malvaceae* sucumbieron ante el ataque de la plaga. Se propuso una estrategia de manejo integrado de plagas (MIP) para un control a largo plazo, con el clásico control biológico como principal componente. El predator *Cryptolaemus montrouzieri* (CM) (*Coleoptera: Coccinellidae*) se introdujo en Trinidad desde la India en Febrero de 1996. Los resultados preliminares del efecto de *C. montrouzieri sobre M. hirsutus* en el Caribe se describen y se cuantifica la situacion actual en el campo en relación a la dinámica de la plaga (MH) y el predator (CM), y se continuará determinanado si el control es sostenible. Los resultados muestran que CM ha sido efectivo en la reducción progresiva de la población del MH por un período de tiempo envés de en forma instantanea. Los resultados guiaran las futuras investigaciones y las decisiones en el uso de *C. montrouziri* como predator en el control de esta potecialmente destructiva plaga, *M. hirsutus*.

Introduction

The hibiscus mealybug (HMB) *Maconellicoccus hirsutus* (Green), was first recorded in Trinidad in June 1995 (McComie, 1995). Chemical and cultural control used for short term containment were ineffective (McComie, 1996a), and within one year the pest was found in all counties, attacking over 100 species of plants including vegetable crops, ornamentals, trees, shrubs and weeds (McComie 1996b). In the absence of effective control many plants, particularly members of the family Malvaceae, succumbed to attack by the mealybug.

An integrated pest management (**IPM**) strategy was proposed for long-term management of the pest, with classical biological control as the main component. One of the candidates, the ladybird beetle predator *Cryptolaemus montrouzieri* (CM) (Coleoptera: Coccinellidae), was introduced to Trinidad from India in February, 1996 (Gautam *et al.*, 1996). This beetle reportedly suppressed **HMB** populations effectively in India and Egypt (Mani, 1989). Field releases of *C. montrouzieri* began in March, 1996 and an assessment exercise was initiated to monitor the impact of the beetle on **HMB** populations. Preliminary results of this assessment on ornamental hibiscus (*Hibiscus rosa-sinensis*) are reported here.

Materials and methods

Data were collected at two locations in Port of Spain, where releases were made in May and July 1996, respectively. Site selection and beetle releases were carried out by the Consultant Dr R.D. Gautam assisted by staff of the Ministry of Agriculture, Land and Marine Resources. Approximately 28 beetle larvae and 10 adults were released per plant. Assessment methods were also developed by the Consultant with modifications by the authors.

Non-destructive sampling was carried out bi-weekly on nine plants at each location. Counts of ovisacs and adult **HMB** were made on the terminal 15 cm of three randomly selected shoots per plant. Counts of **CM** larvae, pupae and adults were done on the entire plant as the sample unit. Actual counts of 50 and under were recorded, and over 50 recorded as >50, >100 and >1000 for both **HMB** and **CM**. Plants at these two "ideal" locations were watered and fertilized regularly as part of the overall landscape maintenance programme.

Results

Results are given in Figure 1 for up to 24 weeks after release of the beetles. The **HMB** population at the time of beetle releases averaged 19 ovisacs and 14 adults per shoot. The population continued to increase from the initial counts and peaked at an average of 17 ovisacs and 34 adults per shoot, approximately four weeks after release of **CM**. From eight to twenty weeks after release, fluctuations of the **HMB** population occurred although at decreasing levels. Significant decline of the **HMB** population below the initial levels first occurred around 12 weeks after release. A population level of seven **HMB** (ovisacs+adults) per shoot was recorded at 16 weeks and below five at 22 weeks after beetle release, at which time the maximum effect of the beetle was realized. Rapid population increases of **HMB** during the 14th and 18th weeks were suppressed within two weeks.

Meanwhile, the population of **CM**

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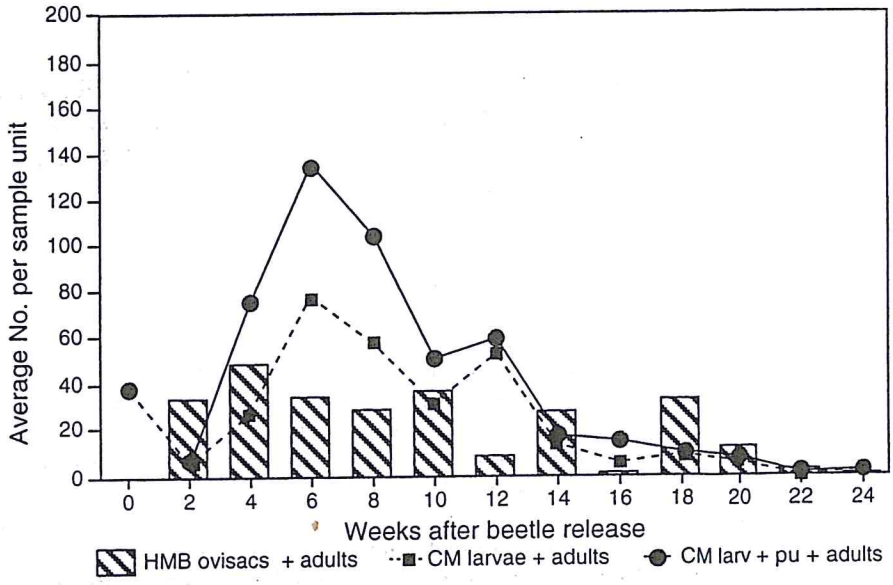

Figure 1: Summary of average biweekly No. of *M. hirsutus* and *C. montrouzieri*
HMB — Hibiscus mealybug, *Maconellicoccus hirsutus*
CM — Ladybird beetle, *Cryptolaemus montrouzieri*
(Prepared May 1997)

declined for the first two weeks, then increased to peak at over 140 insects per plant at six weeks after release (approximately two generations later) This peak in the predator (**CM**) population lagged behind the peak in host (**HMB**) by approximately two weeks. The population of **CM** declined to below five insects (larva + pupae + adults) per sample unit around the same time as the **HMB** population i.e. from 22 weeks after release. There was also evidence of oscillations in the declining populations of both host and predator for the 24-week period. At peak population many of the beetle larvae and adults migrated to nearby plants also infested with **HMB**.

Discussion

This is the first study of the effects of *C. montrouzieri* on *M. hirsutus* in the Caribbean. Although these are preliminary results, they describe and quantify the actual field situation in relation to the dynamics of the pest (**HMB**) and predator (**CM**). Undoubtedly **CM** was effective in progressively reducing the **HMB** population over a extended period of time rather than instantaneously. In India control of **HMB** on grapevines was effected progressively up to six weeks, with significant reductions first noticed in the fourth week after beetle release (Srinivasan and Babu, 1989). The initial decline of the field population of **CM** occurred during a period of acclimatization. The lag in population peaks and oscillation of the pest and predator populations is typical of biological systems where natural enemies are used to control pest populations.

This study will continue to determine whether control of **HMB** by **CM** will be sustained. The effects of factors such as rainfall on **CM** and **HMB** populations will also be observed. These results will inform and guide future research and decision-making regarding the use of *Cryptolaemus montrouzieri* as a predator for controlling the potentially devastating pest, *Maconellicoccus hirsutus*.

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References

Gautam, R.D., De Chi, W. and Maraj, C. 1996. A successful journey of ladybirds from India to Trinidad. **IICA Caraphin News**, 14: 1–2.

McComie, L.D. 1995. Status of the Hibiscus Mealybug *Maconellicoccus hirsutus* (Green) in Trinidad. **Tropical Fruit Newsletter**, 17: 12–13. IICA, Trinidad.

McComie, L.D. 1996a. Incidence and Treatment of the Hibiscus Mealybug *Maconellicoccus hirsutus* (Green) August 1995-February 1996. **First Seminar on the Hibiscus Mealybug**. Research Division, Ministry of Agriculture Land and Marine Resources. April, 1996. Centeno, Trinidad.

McComie, L.D. 1996b. Incidence and treatment of the Hibiscus Mealybug *Maconellicoccus hirsutus* (Green), one year after its discovery in Trinidad. **First Regional Symposium on the Hibiscus Mealybug**. June, 1996. St Georges, Grenada.

Mani, M. 1989. A Review of the Pink Mealybug - *Maconellicoccus hirsutus* (Green). **Insect Science and its Application** 10: 157–167.

Srinivasan, T.R. and Babu, P.C.S. 1989. Field evaluation of *Cryptolaemus montrouzieri* Mulsant, the Coccinellid predator against the grapevine mealybug, *Maconellicoccus hirsutus* (Green). **South India Horticulture** 37: 50–51.

COAT PROTEIN GENE AMPLIFICATION OF A *CITRUS TRISTEZA* VIRUS ISOLATE FROM CUBA

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La Tristeza des Agrumes est une maladie qui détruit des millions d'agrumes à travers le monde. C'est un closterovirus qui est transmis par greffage et par plusieurs espèces de pucerons. Les symptômes du virus (CTV) sont le "stem pitting" et le dépérissement rapide de l'arbre, la nécrose du phloème pouvant entrainer la mort de l'arbre. Des souches faibles de CTV ne produisant pas les symptômes visibles précedemment mentionnés existent. A Cuba, il a été mis en évidence des effets limités de souches faibles de CTV sur l'ensemble des vergers d'agrumes. Dans le cadre de la stratégie de contrôle de cette maladie, la caractérisation des virus isolés détectés à Cuba est actuellement en cours d'étude. Le papier présente les résultats préliminaires de l'amplification du gêne de protéïne d'enveloppe chez un CTV isolé de la province de Havane, à Cuba ainsi que l'analyse de ce gêne. Ces travaux permettront aux scientifiques de séparer les différents virus isolés au sein d'une population de virus, en fonction de la sévérité des symptômes exprimés.

El virus de la tristeza de los cítricos (CTV) es una enfermedad que ha destruido millones de árboles en el mundo. El virus es un clostervirus transmitido por injeratación y por varias especies de áfidos. Los síntomas entre otros, son declinamiento lento o repentino y acanaladuras en el tallo ("st m pitting"), en la cual la necrosis del floema puede causar la muerte de los árboles. Pero hay razas suaves que no producen sintomas visibles. Una baja incidencia de razas suaves de CTV se ha encontrado en Cuba. Como una parte de la estrategia para el control de la enfermedad se estudia las características de los aislamientos del virus. Este trabajo presenta los resultados preliminares de los estudios en la amplificación del gen de la cubierta de proteina de aislamientos del CTV de la provincia de La Habana y el análisis del gen para la proteina de la capside (PC). Esto va permitir a los científicos saparar varios aislamientos en grupos de acuerdo a la severidad de los síntomas expresados.

Introduction

Citrus Tristeza is a very destructive disease that has resulted in the death of millions of citrus plants throughout the world (1). Its causal agent, Citrus Tristeza Virus (CTV) is a closterovirus transmitted by grafts and by several species of aphids. This virus produces multiple biological effects such as: stem pitting and quick decline, in which necrosis of the phloem may cause the death of the tree. There are also mild strains of CTV which do not produce visible symptoms.

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