

activities were more marked, probably reflecting substantial greater microbial group due to the presence of easily decomposable organic compounds. Pressmud has more organic matter (53%) than clay loam soil (23.26%)<sup>13</sup> and the present finding that there was a significantly enhanced phosphatase activity in the PM casts compared to S casts of *E. eugeniae*, was due to the decomposition of the rich organic matter in PM while passing through the gut and also enhanced microbial activity in the PM casts.

A great variety of enzymes are produced by soil micro-organisms, during their metabolism<sup>14</sup>. Soil phosphatases hydrolyse phosphate and make it available to plants. Thus, phosphatase activity measurement provides an index of potential availability of phosphatase in soil<sup>15</sup>. The increased amount of inorganic P released during cast deposition was related to and preceded by increased microbial and phosphatase activity<sup>3</sup>. High P<sub>2</sub>O<sub>5</sub> content in casts supports the phosphatase availability which is required for growth of root, microbial enhancement and in turn, may help drive biological nitrogen fixation<sup>16</sup>. Recently, enhanced phosphate content in the soil and pressmud casts of *L. mauritii* and *E. eugeniae* have been reported<sup>4</sup>. Satchell and Martin<sup>17</sup> have found direct correlation between microbial population and enzyme activity. Microbes like *Pseudomonas* spp.,

*Bacillus* spp. and *Aspergillus* spp. are known to mineralize phosphate<sup>18</sup>. These microbes were found to be rich in the gut content of worm fed on S/PM, S and PM casts of *L. mauritii* and *E. eugeniae*<sup>6</sup>. Since there is no phosphatase activity in the cast of sterilized S and/or PM, it is evident that gut epithelium of worm or even the indigenous microbes of gut does not contribute phosphatase. Hence enhanced phosphatase activity in the casts with more microbial population is microbial rather than by the epithelium of the gut.

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## Presence of a possible retinoblastoma protein binding motif in the AC2 protein of subgroups II and III geminiviruses

Geminiviruses are plant DNA viruses with small genomes, comprising one or two components of circular, single-stranded DNA which are less than 3 kb in size. The limited size of the genomes makes geminiviruses heavily dependent on host factors for their proliferation. Members of *Geminiviridae* can infect terminally differentiated cells<sup>1</sup>. Therefore the viruses must control the cellular environment of these cells to produce conditions suitable to support viral DNA replication. In support of this hypothesis, the Rep proteins of some members of *Geminiviridae* are reported to bind to

mammalian and plant retinoblastoma (Rb) proteins<sup>2,3</sup>. Rb is a cellular protein that sequesters the transcription factors required for cell progression from G1 to S phase<sup>4</sup>. The viral Rep protein (C1 ORF) binds with its LXCXE motif<sup>2</sup>. The present analysis finds a similar conserved motif (LXCXC) in the AC2 ORF of subgroups II and III of *Geminiviridae*.

Subgroup I geminiviruses are those members of *Geminiviridae* that have a monopartite genome and infect monocots. Typical members of this subgroup, like wheat dwarf virus and maize streak virus, have been shown to bind to human

and maize retinoblastoma proteins through one of their complementary sense (C1) gene products<sup>2,3</sup>. The motif in the viral protein implicated in the binding is LXCXE<sup>2</sup>. However, subgroups II and III geminiviruses have not been shown to have such a motif, although the Rep protein (an AC1 ORF) of tomato golden mosaic virus, a member of subgroup III, has been found to bind to Rb<sup>3</sup>. So far, the second complementary sense gene product (AC2) has not been analysed for its Rb binding capacity, although it has been reported to be involved in transactivation of viral gene products<sup>5</sup>. The AC2 ORF

**Table 1.** LXCXC motif in the AC2 protein of subgroup II and III geminiviruses

| Accession no. | Virus                               | Sequence  | Starting position in the AC2 ORF |
|---------------|-------------------------------------|-----------|----------------------------------|
| U88692        | Tomato leaf curl virus              | L P C G C | 35                               |
| Y11097        | Sida golden mosaic virus            | L E C G C | 31                               |
| AF012300      | Taino tomato mottle virus           | L G C G C | 31                               |
| AJ223191      | Chayote mosaic virus                | L E C G C | 35                               |
| U51137        | Abutilon mosaic virus               | L G C G C | 31                               |
| AF058015      | Tomato mottle virus                 | L G C G C | 31                               |
| X70418        | Pepper hausteco virus               | L A C G C | 40                               |
| M88179        | Bean dwarf mosaic virus             | L E C G C | 31                               |
| U57457        | Texas pepper virus                  | L N C G C | 31                               |
| U65529        | Cabbage leaf curl virus             | L N C G C | 31                               |
| X74516        | Ageratum yellow vein virus          | L T C G C | 35                               |
| Z24758        | Indian cassava mosaic virus         | L N C G C | 35                               |
| K02029        | Tomato golden mosaic virus          | L N C G C | 31                               |
| D00940        | Potato yellow mosaic virus          | L D C G C | 31                               |
| AB027465      | Squash leaf curl virus              | L D C G C | 31                               |
| X17095        | African cassava mosaic virus        | L V C G C | 35                               |
| X76319        | Tomato yellow leaf curl virus       | L D C G C | 35                               |
| AJ132575      | <i>V. mungo</i> yellow mosaic virus | L S C G C | 35                               |
| M10070        | Bean golden mosaic virus            | L N C G C | 74                               |
| U56975        | Beet curly top virus (sub grp II)   | L P C K C | 34                               |

**Table 2.** Multiple alignment of the AC2 protein of subgroup II and III geminiviruses created by MACAW program. Region showing the LXCXC motif

|          |  |    |
|----------|--|----|
| U88692   | mrnsspspshsthpikvqhkiakkrp-----IRRRVDLPCGCSYYLGINCashgfshr   | 55 |
| Y11097   | mrsspspshppsiktahrqakkr-----IRRRRIDLECGCSIYFHIGctghgfthr     | 51 |
| AF012300 | mrsspsqppsikiahrgqkkra-----IRRRVDLQCGCSIYFHLNCaghgfthr       | 51 |
| AJ223191 | mppsarspsrstqvpikvqhrigkkka-----IRRRRIDLECGCSFYLHIDCalngfahr | 55 |
| U51137   | mrsspspshppsikkahrqakrra-----IRRRRIDLQCGCSIYFHIDctghgfthr    | 51 |
| AF058015 | mrsspsqppsikrahrgqkkra-----IRRRVDLQCGCSIYFHLGCaghgfthr       | 51 |
| X70418   | mtgskktpstpskklssppevklrhrfakrqIRRRRIDLACGCSIYIHINcVnngfphr  | 60 |
| M88179   | mqssslstppsikkahrqakrra-----IRRRRIDLECGCSIYIHIGctghgfthr     | 51 |
| U57457   | mlnssstlpsikaqhriakkrp-----IRRRRIDLNCGCSIFLHINCanngfthr      | 51 |
| U65529   | mqnssllkppsikaqhkiakrra-----VRRRRIDLNCGCSIFLHINCadngfthr     | 51 |
| X74516   | mrnsspsrghctqvpikvqhriakkrp-----VRRRRVDLTCGCSYYFGIDCanhgfsr  | 55 |
| Z24758   | mrpspskdhytqvpikvqhraakkr-----IRRRVDLNCGCSYYVHINChnhgfthr    | 55 |
| K02029   | mrsssstppsikaqhraakrra-----IRRRRIDLNCGCSIYIHIDCrnngfthr      | 51 |
| D00940   | mrsspsqppsikkahrqakrra-----IRRRRIDLDCGCSIYFHIDCaghgfthr      | 51 |
| AB027465 | mpnssskvpsikaqhriakkr-----VRRRRIDLDCGCSIYIHINcKadnggft       | 51 |
| X17095   | mqsspspnhstqvpikvshrqfkkra-----IRRRVDLVCGCSYYLHINcshngfthr   | 55 |
| X76319   | mqsspstshcsqvsikvqhkiakkkp-----IRRRVDLDCGCSYYLHLNcshngfthr   | 55 |
| AJ132575 | mrnstpsknhfspssikaqhkvakkr-----IRRSRIDLSCGCSYYIHINCrnygfshr  | 55 |
| M10070   | mrsspsqppsikaqhriakrra-----IRRRRIDLNCGCSIFYHIKcAdhgfthr      | 51 |
| U56795   | mkplspglyriqpslnspalslikiq-----KRPRKVNLPCKCHFTIHHDChhgfsht   | 54 |

sequence is known for nineteen subgroup III viruses and one subgroup II virus. Here we report the presence of a conserved LXCXC motif in the AC2 protein of all these twenty viruses (Table 1). The plant virus sequences were fetched from Genbank, EMBL and Swissprot databases. The sequence patterns were identified using FindPatterns of GCG<sup>6</sup>. The initial multiple alignment was made with CLUSTALW<sup>7</sup>. The final block searching and alignment (Table 2) were carried out using MACAW<sup>8</sup>. The statistical significance of the block having high-scoring

sequence segments (LXCXC) was shown to be significant ( $P = 0.0$ ) using Karlin-Altschul statistics<sup>9</sup>. The significance of the Glu (E) residue of the LXCXE motif in the RepA protein of bean yellow dwarf virus was shown by mutating it to Gln (Q)<sup>10</sup> and Lys (K)<sup>11</sup>, which almost completely abolished the binding. However, there are no data available on the effect of a Glu (E) to Cys (C) mutation on Rb binding. The identification of the LXCXC motif suggests the need for experiments to check the Rb binding of the AC2 protein of subgroups III and II gemini-

viruses. The neighbourhood of the motif is also conserved in the subgroup III viruses (it is RRRRID or RRRRVD). In beet curly top virus (Tables 1 and 2), this region is RPRKVN. However, the LXCXC motif is present in the same relative position in the AC2 protein of beet curly top virus also. Our search shows that such a motif is not found in any other group of plant viruses.

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## Is there really a ‘quantum-no-deleting principle’?

A recent issue of *Nature*<sup>1</sup> contains a letter entitled ‘Impossibility of deleting an unknown quantum state’ by Pati and Braunstein (PB). The main contention of PB is that it is impossible to delete an ‘unknown’ quantum state. Further, they claim intrinsic security to files in a quantum computer as a corollary. What they have actually considered is uncopying, which means deleting against a copy. To claim intrinsic security, irreversible deleting must also be considered. We find that their claim is not true even for the (restricted) act of uncopying. To uncopy a state, it is necessary to have at least an additional copy. An uncopying device accepts two identical inputs – the original and a copy – and switches the copy to a standard state while keeping the original intact. This is strictly, called conditional uncopying.

Yuen<sup>2</sup> has defined copying of a quantum state  $|\psi\rangle$  (of two-state system or a q-bit) using the transformation  $T_c$ :

$$T_c|\psi\rangle| \rangle|A\rangle = |\psi\rangle|\psi\rangle|A_\psi\rangle,$$

where  $|\hat{O}\rangle$  is the standard state onto which the copy is made, and  $|A\rangle$  and  $|A_\psi\rangle$  are, respectively, the initial and final states of the copying device (or ancilla). PB define an uncopying transformation,  $T$ , that is analogous to  $T_c$ . The unitary operator  $T$ , which represents a Schrödinger evolution, transforms a composite state  $|\psi\rangle|\psi\rangle|A\rangle$  as

$$T|\psi\rangle|\psi\rangle|A\rangle = |\psi\rangle|\hat{O}\rangle|A_\psi\rangle. \quad (1)$$

PB attempt to show that if  $T$  exists for the orthogonal basis states, then, linearity of quantum mechanics will prevent it from working for any superposed state. We show that PB’s arguments are untenable, and hence, there is nothing like a ‘quantum no-deleting principle’.

The operational part of PB’s ‘derivation’ is very simple: They assume that the operator  $T$  exists for two orthogonal states  $|H\rangle$  and  $|V\rangle$ . Thus

$$T|H\rangle|H\rangle|A\rangle = |H\rangle|\hat{O}\rangle|A_H\rangle, \quad (2)$$

$$T|V\rangle|V\rangle|A\rangle = |V\rangle|\hat{O}\rangle|A_V\rangle, \quad (3)$$

where  $T|A_H\rangle$  and  $|A_V\rangle$  are the final states of the device. Now, the question is whether the same  $T$  can uncopy a state obtained as an arbitrary linear superposition,  $|\psi\rangle = \alpha|H\rangle + \beta|V\rangle$ , with  $|\alpha|^2 + |\beta|^2 = 1$ . (It may be noted that eqs (2) and (3) by themselves do not define  $T$  for the complete Hilbert space.) After a few simple steps, one finds that this is indeed possible with an appropriate  $|A_\psi\rangle = (\alpha|A_H\rangle + \beta|A_V\rangle)$ . Also the entangled state,  $(|H\rangle|V\rangle + |V\rangle|H\rangle)|A\rangle$ , transforms to  $(|H\rangle|\Sigma\rangle|A_V\rangle + |V\rangle|\Sigma\rangle|A_H\rangle)$ . Thus, the conclusion should have been that the sought after transformation is indeed possible – though it has not been constructed explicitly. However, at this point PB take a different view. They observe that  $|A_H\rangle$

and  $|A_V\rangle$  are orthogonal and  $|A_\psi\rangle$  is a linear superposition of them, and then claim, ‘The transformation is therefore not uncopying at all, but merely swapping onto a two-dimensional sub-space of the ancilla. It appears that there is no option but to move the information around without deleting it’ (emphasis is ours).

We state a consequence directly following from the definition, eq. (1). The orthogonality of  $|A_H\rangle$  and  $|A_V\rangle$  follows from unitary property of operator  $T$ . For instance let  $|A_{\sigma_1}\rangle$  and  $|A_{\sigma_2}\rangle$  be the ancilla states corresponding to two states  $|\psi_1\rangle$  and  $|\psi_2\rangle$ , respectively, in eq. (1). Then one may argue using unitarity of  $T$  and continuity of scalar product  $\langle\psi_1|\psi_2\rangle$  that orthogonality of  $|\psi_1\rangle$  and  $|\psi_2\rangle$  implies that of  $|A_{\sigma_1}\rangle$  and  $|A_{\sigma_2}\rangle$ . (Since this is true for every unitary operator  $T$ , the mere orthogonality of  $|A_H\rangle$  and  $|A_V\rangle$  cannot be the deciding factor as to whether  $T$  represents uncopying or swapping.)

Also, one might wonder why there is a sudden concern about swapping. (A swapping operator on the state  $|\psi_1\rangle|\psi_2\rangle$  of two q-bits, transforms it to  $|\psi_2\rangle|\psi_1\rangle$ .) PB had advanced the following argument for not considering swapping as uncopying. According to them, ‘The standard erasure of  $|\psi\rangle$  does not use the original (i.e. first  $|\psi\rangle$ ), and so is the case, if  $T$  swaps the copy (i.e. second)  $|\psi\rangle$  and  $|A\rangle$ ’. They thereby imply the equivalence of swapping and erasure. But, erasure is not reversible, while swapping of two states