Madras agric. J. 66 (2): 118 - 121, Feb., 1979

## Black Pepper as a Grain Protectant

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Ground black pepper and its crude extract were found to be good surface protectants of rice and greengram against the attack by rice moth and cowpea weevil for 4 months. Crude extract was highly toxic to the rice moth, rice weevil lesser grain borer, red flower beetle and cowpea weevil at higher concentrations when applied topically.

Black pepper (the dried unripe fruit of Piper nigrum), a widely used spice in the tropical countries, is known to be a toxicant to house fly (Harwill et al. 1943: Synerholm et al., 1945) a repellent to corn earworm (Freeborn and Wymore, 1929), a protectant of vellow eyebeans (Lathrop and Keirstead, 1946) and a synergist of pyrethrins (Nakayama, 1950). Su (1977) reported the toxic nature of black pepper to rice weevil, Sitophilus oryzae (L.) and cowpea weevil, Callosobruchus maculatus (F.). In this paper, the results of laboratory studies on the toxicity of black pepper to some pests of stored products are presented.

## MATERIAL AND METHODS

Black pepper powder and its crude extracts were prepared as per the method described by Su (1977). Grains of maize, cholam, green gram and unhusked paddy were used to test the toxicity of black pepper to the adults of rice weevil. Sitophilus oryzae (L.),

red flour beetle, Tribolium castoneum (Herbest), cowpea weevil, Callosobruchus chinensis (L.) and lesser grain borer. Rhizopertha dominica (F.) and larvae of rice moth, Corcyra cephalonica Staint. Black pepper powder and crude pepper extract in acetone were applied separately to the above grains in glass jars at 5000, 2500, 1250, 625 and 500 ppm. Ten pairs of adults of rice weevil, lesser grain borer, cowpea weevil and red flour beetle and 100 larvae of rice moth were introduced at monthly intervals and the mortality counted after 72 hr. The insects alive at the end of 72 hr, were removed and the jars examined daily for emergence. The experiment replicated thrice with untreated and acetone treated hosts serving as controls.

The necessary amount of crude pepper extract was dissolved in acetone to get the desired concentrations for treating the insects. Insects anesthetised with Co 2 were treated with 0.5 ml of

TABLE 1 Effect of surface treatment of seeds with ground black popper powder and crude black pepper extract on different stored product posts.

| Pariod before   Pariod befor   |                   |                 |          | GROUND              | BLACK              | PEPPER |                          | CRUDE          | BLACK PEPPER             | ER EXTRACT | ACT  |       |
|--|-------------------|-----------------|----------|---------------------|--------------------|--------|--------------------------|----------------|--------------------------|------------|------|-------|
| Docaçio   Docaçio   Post treatment period   Period before   Period before   Docaçio   Isla commutation   Docaçio   Isla commutation   Docaçio   Isla commutation      |                   |                 |          |                     |                    |        |                          | etment         |                          |            |      |       |
| Rice Moth   Rice   |                   | Dosaga<br>(ppm) |          | Post treatm<br>(Mon | ent period<br>ths) | Pe.    | riod before<br>emergence | Po             | st treatment p<br>months | eriod      | ,,=  | F     |
| SCARCHUM 1250 100.0 92.0 71.0 41.5 100.0 83.5 81.5 89.5 82.5 82.5 10.0 82.5  |                   |                 |          | 2                   | e                  | 0      | (days)                   |                | 2                        | e          | 14   |       |
| SORCHUM 1250 100.0 92.0 71.0 41.5 147 100.0 92.5 81.5 89.5 89.5 80.5 80.5 80.5 80.5 80.5 80.5 80.5 80  |                   |                 | t .      | t)                  |                    |        |                          | Ric            |                          |            |      |       |
| SORGHUM 1250 100.0 90.0 42.5 11.0 100.0 88.5 52.5 52.5 52.5 52.5 50.5 52.5 50.5 50   |                   | 5000            | 100.0    | 92.0                | 71.0               | 41.5   | 147                      | 100.0          | 93.5                     | 81.5       | 59,5 | 148   |
| Company   Comp   |                   | 2500            | 100.0    | 90.0                | 59.5               | 38.0   | 140                      | 100.0          | . 88.5                   | 69.5       | 52,5 | 145   |
| FAUDY   1750   1770   1770   1750     | SORGHUM           | 1250            | 100.0    | 70.5                | 42.5               | 0.1    | 92                       | 100.0          | 72.5                     | 57.5       | 19.0 | 95    |
| Lesser Grain Borer  FAUDY 1250 100 90.0 72.0 47.5 97 100.0 89.5 65.0 47.5 95.0 100.0 89.5 65.0 47.5 95.0 100.0 80.5 52.5 38.6 95 100.0 89.5 50.0 42.5 50.0 89.5 50.0 42.5 50.0 89.5 50.0 42.5 50.0 89.5 50.0 42.5 50.0 89.5 50.0 42.5 50.0 89.5 50.0 42.5 50.0 89.5 50.0 42.5 50.0 89.5 50.0 42.5 50.0 89.5 50.0 42.5 50.0 89.5 50.0 42.5 50.0 89.5 50.0 42.5 50.0 89.5 50.0 42.5 50.0 89.0 50.0 89.0 50.0 89.0 50.0 89.0 50.0 89.0 50.0 89.0 50.0 89.0 50.0 89.0 50.0 89.0 50.0 100.0 80.0 80.0 100.0 100.0 80.0 100.0 80.0 100.0 80.0 100.0 80.0 100.0 80.0 100.0 8  |                   | 500             | 67.5     | 29.5                | 15.0               | 0.0    | 48                       | 642.0          | 38.5                     | 22.0       | 11.5 | 79    |
| PADDY         5500<br>1350<br>1350<br>100.0         100 0<br>100.0         90.0<br>100.0         47.5<br>12.5<br>12.0         97<br>100.0         100.0<br>100.0         89.5<br>12.5<br>12.0         65.0<br>14.0<br>12.5<br>12.0         47.5<br>12.0         97<br>100.0         100.0<br>100.0         89.5<br>12.5<br>12.0         65.0<br>12.5<br>12.0         44.0<br>12.5<br>12.0         44.0<br>12.5<br>12.5<br>12.0         44.0<br>12.5<br>12.5<br>12.0         44.0<br>12.5<br>12.5<br>12.0         44.0<br>12.5<br>12.5<br>12.0         44.0<br>12.5<br>12.5<br>12.5<br>12.5<br>12.5<br>12.5<br>12.5<br>12.5  |                   | Le              |          | Borer               | i i                |        | <u>}</u> .               |                |                          |            |      | 2     |
| PAUDY 1250 100 87.5 52.5 38.5 95 100.0 84.5 57.5 47.0 50.0 100.0 87.5 52.5 38.5 95 100.0 84.5 57.5 47.0 50.0 100.0 87.5 51.0 28.5 12.0 68 9.0 100.0 89.0 57.5 51.0 28.5 12.0 68 9.0 100.0 89.0 57.5 51.0 28.5 12.0 68 9.0 100.0 92.0 57.0 41.0 30.0 87.5 51.0 100.0 92.0 57.0 100.0 92.0 57.0 11.5 50.0 100.0 92.0 11.5 50.0 100.0 92.0 11.5 50.0 100.0 92.0 11.5 50.0 100.0 92.0 11.5 50.0 100.0 100.0 11.5 50.0 100.0 100.0 11.5 50.0 100.0 100.0 11.5 50.0 100.0 100.0 100.0 11.5 50.0 11.5 50.0 100.0 100.0 100.0 11.5 50.0 100.0 100.0 100.0 11.5 50.0 11.5 50.0 10 |                   | 5000            |          | 90.0                | 72.0               | 47.5   | 45                       | 100 0          | 20 21                    | 0          |      |       |
| PAUDY 1356 100.0 80.5 42.0 31.5 92 100.0 89.0 50.0 42.5 50.0 42.5 50.0 42.5 50.0 42.5 50.0 42.5 50.0 42.5 50.0 42.5 50.0 42.5 50.0 42.5 50.0 42.5 50.0 40.0 30.0 40.0 30.0 40.0 30.0 40.0 4  |                   | 2500            | 1000     | 87.5                | 52.5               | 38.2   | 0                        | 0.001          | 20.00                    | 0.00       | 0.0  | 92    |
| SORGHUM 1250 95.5 72.6 37.5 12.0 68 96.0 79.5 48.8 31.5 31.5 50.0 100.0 91.0 72.0 67.0 125 100.0 91.5 77.0 125 100.0 91.5 77.5 91.0 91.5 77.5 91.0 91.5 77.5 91.0 91.5 77.5 91.0 91.5 77.5 91.0 91.5 77.5 91.0 91.5 77.5 91.0 91.5 77.5 91.0 91.5 77.5 91.0 91.5 77.5 91.0 91.5 77.5 91.0 91.5 77.5 91.0 91.5 77.5 91.0 91.5 77.5 91.0 91.5 77.5 91.0 91.5 77.5 91.0 91.5 77.5 91.0 91.5 91.0 91.5 91.0 91.5 91.0 91.5 91.0 91.5 91.0 91.5 91.0 91.5 91.5 91.0 91.5 91.5 91.0 91.5 91.5 91.0 91.5 91.0 91.5 91.0 91.5 91.0 91.5 91.0 91.5 91.0 91.5 91.0 91.5 91.0 91.5 91.0 91.5 91.0 91.5 91.0 91.5 91.0 91.5 91.0 91.5 91.0 91.5 91.0 91.5 91.0 91.5 91.5 91.0 91.5 91.5 91.0 91.5 91.5 91.0 91.5 91.5 91.0 91.5 91.5 91.5 91.5 91.5 91.5 91.5 91.5   |                   | 1250            | 100.0    | 80.5                | 42.0               | 31.5   | 92                       | 100.0          | 0 68                     | 20.00      | 20.0 | 90.0  |
| SORGHUM 1250 67.5 51.0 28.5 12.0 62 63.5 57.0 47.0 30.0 80.0 100.0 91.0 72.0 57.0 125 100.0 92.0 77.0 51.0 50.0 82.0 100.0 82.0 67.0 17.5 125 100.0 92.0 77.5 51.0 51.0 52.5 50.0 100.0 82.0 67.5 41.0 75.5 98.0 59.5 77.5 47.5 50.0 100.0 82.0 17.5 75 98.0 59.5 77.5 47.5 50.0 100.0 100.0 72.0 72.0 11.5 75 55.0 41.0 12.5 82.5 17.5 17.5 82.5 17.5 17.5 17.5 17.5 17.5 17.5 17.5 17  |                   | 625             | 95.5     | 72.5                | 37.5               | 22.0   | 68                       | 0.96           | 2007                     | AR.        | 2,75 | 26    |
| Red Flour Beetle   |                   | 200             | 67.5     | 51.0                | 28.5               | 12.0   | 62                       | 63,5           | 57.0                     | 41.0       | 30.0 | 77    |
| 5000 100.0 91.0 72.0 57.0 125 100.0 92.0 77.0 51.0 52.5 1250 100.0 92.0 77.0 51.0 77.5 51.0 77.5 51.0 77.5 52.5 77.5 51.0 77.5 50.0 92.0 77.5 51.0 77.5 51.0 77.5 50.0 92.0 77.5 51.0 77.5 51.0 77.5 50.0 10.0 92.0 77.5 51.5 77.5 51.5 77.5 51.0 12.5 50.0 11.5 7.5 50.0 100.0 92.0 72.0 72.0 72.0 72.0 72.0 72.0 72.0 7  |                   | -               | Flour    | eetle               |                    |        |                          | -              | lour Beetle              |            |      | 3     |
| 2500 100.0 82.0 67.0 32.5 120 100.0 91.5 77.0 22.5 88.0 62.5 88.0 62.5 37.0 22.5 88.0 62.5 88.0 62.5 37.0 22.5 88.0 62.5 88.0 12.5 88.0 62.5 88.0 12.5 88.0 12.5 88.0 12.5 88.0 12.5 88.0 12.5 88.0 10.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0   |                   | 5000            | 1000     | 0.10                | 72.0               | 57.0   | 105                      |                | 000                      | 1          | 1    | 3     |
| 1250   88.0   52.5   31.0   17.5   75   98.0   59.5   37.0   27.5     500   48.5   38.5   30.0   11.5   75   56.0   43.0   12.5     5000   100.0   72.0   27.0   6.5   65   65   68.5   31.0   14.0     5000   100.0   72.0   27.0   6.5   65   65   68.5   31.0   14.0     5000   100.0   72.0   27.0   6.5   65   65   68.5   31.0   14.0     5000   11.5   0.0  |                   | 2500            | 1000     | 82.0                | 67.0               | 32.5   | 120                      | 100.0          | 0.20                     | 1,5        | 0.10 | 132   |
| 625 67.5 41.0 22.0 11.5 75 56.0 43.0 12.5 8.5 8.5 8.5 8.5 8.5 8.5 8.5 8.5 8.5 8  | SORGHUM           | 1250            | 88.0     | 52 5                |                    | 171    | 47                       | 200            | 2 10                     | 0,0        | 47.5 | 120   |
| 500         48.5         38.5         9.0         0.0         62         51.6         42.5         17.5         12.5           5000         100.0         72.0         27.0         6.5         6.5         67         100.0         68.5         31.0         14.0           5500         100.0         72.0         27.0         6.5         65         55.0         68.5         17.5         14.0           5500         27.0         11.0         0.0         -         -         42         31.0         22.5         17.5         10.5           625         27.0         11.0         0.0         -         -         37         12.5         6.5         0.0         -         -         37         17.5         10.5         0.0         -         -         -         37         7.0         0.0         -         -         -         37         7.0         0.0         -         -         -         37         7.0         0.0         -         -         -         32         0.0         -         -         -         -         -         -         -         -         -         -         -         -         -         -   |                   | 625             | 67.5     | 41.0                | 22.0               |        | 7.5                      | 26.0           | 42.0                     | 200        | 22.5 | 68    |
| Rica Weavil  |                   | 200             | 48.5     | 38,5                | 9.0                | 0.0    | 62                       | 51.5           | 42.5                     | 2,00       | 2.0  | 74    |
| 5000         100.0         72.0         27.0         6.5         67         100.0         68.5         31.0         14.0           2500         52.0         32.0         23.0         5.0         5.0         41.0         28.0         11.5           1250         27.0         11.0         0.0         -         42         31.0         22.5         17.5         10.5           625         11.5         0.0         -         -         42         37.0         0.0         -   |                   |                 |          | eevil               |                    |        | 4                        |                | 1.7                      |            |      | 0     |
| 2500 52.0 32.0 23.0 5.0 55 55.0 41.0 28.0 11.5 625 17.5 10.5 625 11.5 0.0 - 42 31.0 22.5 17.5 10.5 625 11.5 0.0 - 37 12.5 6.5 0.0 - 37 12.5 6.5 0.0 - 20.0 - 37 12.5 6.5 0.0 - 20.0 - 20.0 - 20.0 - 20.0 - 20.0 - 20.0 - 20.0 - 20.0 - 20.0 - 20.0 - 20.0 - 20.0 20.0  |                   | 5000            | 100.0    | 72.0                | 27.0               | ir.    | 67                       | 100            | 000                      |            |      | 0.00  |
| 1250 27.0 11.0 0.0 — 42 31.0 22.5 17.5 10.5 625 17.5 10.5 625 11.5 0.0 — 37 12.5 6.5 0.0 — 37 12.5 6.5 0.0 — 50.0 — 32 7.0 0.0 — 50.0 — 50.0 — 65.0 0.0 — 65.0 0.0 — 65.0 0.0 — 65.0 0.0 — 65.0 0.0 — 65.0 0.0 — 65.0 0.0 — 65.0 0.0 — 65.0 0.0 — 65.0 0.0 — 65.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  |                   | 2500            | 52.0     | 32.0                | 23.0               | 5.0    | 52                       | 55.0           | 0.17                     | 0.00       | 0.41 | 89    |
| 625 11.5 0.0 — 37 12.5 6.5 0.0 — 50.0 50.0 — 32 7.0 0.0 0.0 — 50.0 5.0 0.0 — 50.0 0.0 — 50.0 0.0 — 50.0 0.0 — 50.0 0.0 — 50.0 0.0 — 50.0 0.0 — 50.0 0.0 — 50.0 0.0 — 50.0 0.0 0.0 0.0 0.0 — 50.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 — 50.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.   | MAIZE             | 1250            | 27.0     | 11.0                | 0.0                | 1      | 42                       | 31.0           | 22.5                     | 17.5       | 2 1  | 29    |
| 500         5.0         0.0         2           Cowpea Weavil         Cowpea Weavil         Cowpea Weavil           5000         98.0         100.0         67.0         52.0         162         100.0         91.5         72.6         64.0           2500         100.0         87.0         67.5         50.0         160         90.5         58.5         52.5           1250         97.0         92.0         54.5         42.5         142         93.5         82.5         52.5         50.5           625         88.0         64.5         41.5         27.5         130         78.5         64.5         41.5         36.5           500         62.0         57.5         17.6         11.0         82         67.5         51.5         12.0   |                   | 625             | 11,5     | 0.0                 | 1                  | , )    | 37                       | 12.5           | 6.5                      |            | 9    | 00.   |
| Cowpea Weavil         Cowpea Weavil         Cowpea Weavil           5000         98.0         100.0         67.0         52.0         162         100.0         91.5         72.5         64.0           2500         100.0         97.0         97.0         97.0         90.5         58.5         52.5           1250         97.0         92.0         54.5         42.5         142         93.5         82.5         52.5         50.5           625         88.0         64.5         41.5         27.5         130         78.5         64.5         41.5         36.5           500         62.0         57.5         17.6         11.0         82         67.5         51.5         12.0   |                   | 200             | 5,0      | 0.0                 | Ť.                 | Τ      | 32                       | 7.0            | 0.0                      | 1          | l °I | 2 4 6 |
| 5000 98.0 100.0 67.0 52.0 162 100.0 91.5 72.5 64.0 2500 100.0 97.5 52.5 52.5 52.5 50.5 1250 92.0 92.0 54.5 42.5 130 78.5 64.5 52.5 50.5 50.5 50.5 50.5 50.5 50.5 50  |                   |                 | Cowpea W | eavil               |                    |        |                          | ပိ             | wpea Weev                | =          |      |       |
| 2500 100.0 87.0 67.5 50.0 160 100.0 90.5 58.5 52.5 1250 97.0 92.0 54.5 41.5 27.5 11.0 82 67.5 51.5 21.5 12.0   |                   | 2000            | 98.0     | 100.0               | 67.0               | 52.0   | 162                      |                | 5 15                     |            | 9    | 1     |
| 1250 92.0 92.0 54.5 42.5 142 93.5 82.5 52.5 50.5 52.5 50.5 50.5 50.5 50.5 5  |                   | 2500            | 100.0    | 87.0                | 67.5               | 50.0   | 160                      | 100.0          | 90.5                     | מ מ        | 200  | 500   |
| 625 88,0 64.5 41.5 27.5 130 78.5 64.5 41.5 36.5 500 52.0 57.5 17.5 11.0 82 67.5 51.5 21.5 12.0   | GREENGRAM         | 1250            | 92,0     | 92.0                | 54,5               | 42.5   | 142                      | 93.5           | 82.5                     | 20.00      | 50°0 | 10.   |
| 500 52.0 57.5 17.5 11.0 82 67.5 51.5 21.5 12.0   |                   | 625             | 98,0     | 64.5                | 41.5               | 27.5   | 130                      | 78.5           | 64.5                     | 41.5       | 36.5 | 0.4.0 |
| 32 acetone treated -   |                   |                 | 62.0     | 57.5                | 17.5               | 11.0   | 82                       | 67.5           | 51.5                     | 21.5       | 12.0 | 240   |
|  | Control Unitedate | 0               | ı        | I                   | ١                  | 1      | 32                       | acetona treate |                          | 1          | 1    | à c   |

TABLE II Influence of topical application of crude black pepper extract on some stored product pests.

| c                            |     |         |      |   |     | AV          | Average % Mortality (Days) | Mortality | / (Days   |     |     |            |     |                    |                |      |
|------------------------------|-----|---------|------|---|-----|-------------|----------------------------|-----------|-----------|-----|-----|------------|-----|--------------------|----------------|------|
| (rg/insect)                  | 1   | Corcyra |      |   | Rhi | Rhizopertha | 8                          | -         | Tribolium |     | S   | Sitophilus | 9   | Call               | Callosobruchus | hus  |
|                              | 8   | ts.     | 7    |   | е   | 2           | -                          | в         | 2         | ~   | 8   | 2          | -   | .60                | 9              | _    |
| 20                           | 100 | 1       | .1   | * | 100 | 1           | į                          | 92        | . \$6     | 100 | 100 | 1          | .1  | 100                | Ť              | 1    |
| 25                           | 100 |         | į    |   | 100 | -1          | 1                          | 90        | 92        | 100 | 86  | 100        | 1   | 100                | ţ              | 1    |
| 12.5                         | 06  | 92      | 92   |   | 100 | 1           | ŧ                          | 88        | 2         | 90  | 100 | F          | 1   | 97                 | 100            | · 1. |
| 6,25                         | 90  | 90      | 90   |   | 06  | 92          | 92                         | 72        | 76        | 75  | 92  | 93         | 100 | 16                 | 26             | 100  |
| 6.0                          | 70  | 72      | 75   |   | 84  | 88          | 38                         | 42        | 45        | 52  | 88  | 90         | 100 | o <sub>6</sub>     | 92             | 96   |
| 2.5                          | 62  | 65      | . 59 |   | 62  | 2.5         | . '62                      | 32        | 36        | 32  | 72  | 75         | 78  | 60                 | 09             | 62   |
| 1.0                          | 48  | 90      | 55   |   | 22  | 33.         | 60                         | 15        | 15        | 13  | 52  | 55         | 55  | 42                 | 42             | 45   |
| Control<br>(Acetone treated) | Ē   | ř       | ŀ    |   | Ĩ.  | 1.          | = <b>†</b>                 | ţ         | Ĭ         | 1   | 1   | 1          | *   | $\tau^{\tilde{r}}$ | 4              | 1    |
|                              |     |         |      |   |     |             |                            | ٠         |           |     | į   |            |     |                    |                |      |

the solution with a microsyringe applicator (C.S.I.R. Laboratory, Jammu-Tawi). Insects treated with solvent alone served as control. Each treatment consisted of 100 insects and the treated insects were confined to 200 mm petridishes with host grains. The dishes were examined for dead insects every 24 hr for 7 days.

## RESULTS AND DISCUSSION

The surface protectant property of the black pepper is set out in Table I. Even at the lowest concentration (500 ppm) both the ground black pepper the crude pepper extract were toxic to the insects tested. However. at concentrations less than 2500 ppm rice weevil was not affected. Overall, the ground black pepper and the pepper extract at 5000 and 2500 ppm afforded absolute protection to the seeds for the first 2 months and thereafter, their effectiveness decreased to varving However, at 5000 ppm degrees. concentration the residue effectiveness was observed nearly upto 4 months in sorghum and greengram affording protection to grains for about 145 days against the rice moth and cowpea weevils. It is possible that the high mortality of insects exposed to higher concentrations of ground black pepper and crude extract might be due to their enhanced activity as stomach or contact poison.

The toxicity of crude extract of black pepper when applied topically to

different stored product pests is presented in Table II. It caused a very high mortality of insects tested. A direct relationship was observed between the concentration of crude pepper extract and the mortality of different insects tested. Thus, the studies indicate that the black pepper is a potential, safer insesticide to many of the stored product pests but for the prohibitive cost. (Further critical studies are in progress to test whether any feller material could be used to reduce the cost without any loss in the insecticidal value )

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