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# INFLUENCE OF SEED TREATMENT, STORAGE CONTAINERS AND STORAGE PERIODS ON STORABILITY OF THE FEMALE PARENT OF TOMATO COTH 2

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**ABSTRACT**
A laboratory experiment was conducted in department of Seed Science and Technology, Tamilnadu Agricultural University to evaluate the effect of different seed coating materials and storage containers on germination, seedling vigour and suitability of packaging material for tomato seed. Seed of tomato hybrid COTH2 was used for coating purpose with 5 coating treatments viz., T1 (control), T2 (Polymer coating i.e. Polykote @ 3 ml kg-1 of seed diluted with 5 ml of wate Coating the seed with Polymer (Pink poly coat @ 3g $kg^{-1}$ + 2 ml of water) [P]), T3 ( [P] + Slurry treatment with Carbendazim (Bevistin) @ 2 g $kg^{-1}$ of seed using 5 ml water ), T4 ([P] + Slurry treatment with Imidachloprid @ 2 ml $kg^{-1}$ of seed using 5 ml of water), T5 ((P) + Slurry treatment with Carbendazim (Bevistin) + Imidachloprid @ 2 g + 2 ml $kg^{-1}$ of seed using 5ml of water). The treated seeds was stored in three types of containers i.e Polyethylene bags (300 gauge), Plastic containers, Poly laminated aluminum foil pouches and the monthly observation on germination and seedling vigour were recorded. Among the seed treatments maximum germination percentage was recorded in T5 ((P) + Slurry treatment with Carbendazim (Bevistin) + Imidachloprid @ 2 g + 2 ml $kg^{-1}$ of seed using 5ml of water), which was significantly higher than rest of the treatments. After 10 months of the storage Polythene laminated aluminum foil pouches recorded the maximum germination percentage and vigour index

**KEYWORDS:** Seed Polymer coating, Storage Tomato storage container.

## INTRODUCTION

Seed storage is an essential segment of seed industry. In storage, viability and vigour of the seeds is regulated by many physico-chemical factors like moisture content of the seed atmospheric humidity, temperature, and initial seed quality, physical and chemical composition of seed, gaseous exchange, storage structure and packaging materials. Polymer coating is used in pharmaceutical and confectionary industries for uniform application of material to seeds. The film formulation consists of mixture of polymer, plasticizer and colorants that are commercially available as ready to use as liquids (Ni, 1997).

In general, temperature and moisture content are the two most important factors that determine the storability of orthodox seeds. Vegetable seeds belong to the orthodox group and the storability of these seeds are influenced by many factors such as seed moisture content, seed treatment, storage containers, storage structures, storage environment and the storage periods.

Gill and Cbninnan (1983) stored tomato seeds in paper bags up to 6 years and noted that the effects of laboratory germination and field emergence that deteriorated with advanced storage period. Tomato seeds of cv. CO 2 found to maintain 85 and 76 per cent germination over a period of 15 months and 21 months, respectively, when stored at 7 per cent moisture in paper-aluminum foil-polyethylene laminated pouch and gada cloth bag, respectively, after a common pesticidal seed treatment as per Vadivelu and Ramaswamy (1983).

## MATERIALS & METHODS

The of parental lines tomato LCR 2 (female parent) were given with pre storage seed treatment and packed in different containers as detailed below and were stored under ambient conditions of Coimbatore. .

**Seed treatment**

- Control
- Coating the seed with Polymer (Pink for Female and yellow for Male @ 3g $kg^{-1}$ + 2 ml of water) (P)
- (P) + Slurry treatment with Carbendazim (Bevistin) @ 2 g $kg^{-1}$ of seed using 5 ml water (C)
- (P) + Slurry treatment with Imidachloprid @ 2 ml $kg^{-1}$ of seed using 5 ml of water (I)
- (P) + Slurry treatment with Carbendazim (Bevistin) + Imidachloprid @ 2 g + 2 ml $kg^{-1}$ of seed using 5ml of water

**Storage Containers**

- Polyethylene bags (300 gauge)
- Plastic containers
- Poly laminated aluminum foil pouches

Then the seed samples were drawn at monthly intervals upto ten months and evaluated for the following seed and

seedling quality characters. Then the seed samples were drawn from the monthly intervals up to ten months and evaluated for the following seed and seedling quality character viz moisture content (%)

$$\text{Moisture content (\%)} = \frac{M_2 - M_3}{M_2 - M_1} \times 100$$

Where,

$M_1$=Weight of the container.

$M_2$=Weight of the container + Initial weight of the sample.

$M_3$=Weight of the container + weight of the sample after drying.

Germination percentage (ISTA 1999), root length (cm), shoot length (cm), vigour index. (Abdul Baki and Anderson, 1973).

## RESULTS & DISCUSSION

Genotype is one of the intrinsic characters that influences the deteriorative rate of seed in storage. Vir (1983), Singh *et al*. (1996), Dharmasena and Subasinghe (1986) and Rabindra and Mohan (2002) expressed that genetic difference existed for the preference of the genotype. Anon (1999) expressed possibility of seed in many crops *viz.*, paddy, maize, pearl millet and vegetables for mesobiotic storage upto 18 months at various ambient storage conditions of India. Among these, pre storage seed treatments and packaging materials had their pronounced impact on the storability in view of their protection rendered against the biotic factors and irreversible deterioration (Barros *et al*., 1983, Burris, 2002).

Highly significant results were obtained with the evaluated parameters (moisture content, germination, root length, shoot length and vigour index) for the seed treatments (T), storage containers(C) and the periods of storage (P) for both the parental lines of tomato hybrid COTH-2. The interaction between seed treatment (T) and storage containers (C) (T X C), seed treatments (T) and periods of storage (P) (T X P), storage containers (C) and periods of storage (P) (C X P) were highly significant for all parameters. The interaction between seed treatment, containers and periods of storage were most significant for most of the characters.

**Moisture content (%)**

Storability of seeds is determined by wide number of factors *viz.*, period of storage (Manikandan, 2008) initial seed quality (Maranville and Clegg, 1977), storage environment (Justice and Bass, 1978), seed moisture content and seed treatment (Basu and Rudrapal, 1980). In tomato LCR 2, the moisture content was maximum (8.5%) with control and the minimum (8.1%) was with seeds treated with pink polycoat + Carbendazim + Imidachloprid @ 3 g + 2 g + 2ml + 5ml water $kg^{-1}$ of seed. Among the containers polythene bag recorded the highest value (8.5%), while the seeds stored in polythene laminated aluminum foil pouches recorded the minimum (8.0%) percentage. The moisture content recorded with the periods of storage was the maximum at $10^{th}$ month after storage (9.4%) and was the lowest at initial evaluation (7.2%). In T X C interaction effect, irrespective of the containers control recorded the highest value. In TXP interaction at all periods of storage control recorded the highest value. In C X P interaction at all periods of storage polythene bag container recorded the maximum value (9.6%) The interaction effect between T X C X P was also highly significant (Table.1) .

**Germination (%)**

The storage of seeds assumes paramount importance in a seed production programme. The storability of seed is influenced by several factors. Besides the chemical composition (Maranvilla and Clegg, 1977), seed treatments and the containers used for storage also decide the shelf life of seeds under ambient conditions of storage (Vanangamudi and Ramasamy, 1984, Vijayakumar *et al.*, 1991). In tomato LCR 2, the higher germination percentage (84%) was recorded with seed treated with pink polycoat + Carbendazim + Imidachloprid @ 3 g + 2 g + 2 ml + 5 ml water $kg^{-1}$ of seed and the minimum (80%) was with control. Among the containers Polythene laminated aluminum foil pouches recorded the highest value (84%), while Polythene bag recorded the lowest (82%) percentage. The germination percentage recorded with the periods of storage was maximum with initial evaluation (90%) and the lowest was with $10^{th}$ month after storage (75%). In T X C interaction effect, irrespective of the containers pink polycoat + Carbendazim + Imidachloprid @ 3 g + 2 g + 2 ml + 5 ml water $kg^{-1}$ of seed recorded the highest value in T X P interaction, at all periods of storage (pink polycoat + Carbendazim + Imidachloprid @ 3 g + 2 g + 2ml + 5ml water $kg^{-1}$ of seed) treatment recorded the highest value (92%). In C X P interaction, at all periods of storage polythene laminated aluminum foil pouches recorded the higher percentage The interaction, between T X C X P was also highly significant (Table 2).

**Vigour Index**

In tomato LCR 2, the maximum vigour index was (1714) recorded for seed treated with pink polycoat + Carbendazim + Imidachloprid @ 3 g + 2 g + 2 ml + 5 ml water $kg^{-1}$ of seed and minimum (1507) was with control. Among the containers polythene laminated aluminum foil pouches recorded the highest value (1680), while polythene bag recorded the minimum (1574) values. On account of the diverse biological activities taking place in seed during storage, the seed deteriorates in quality, resulting in impairment of germination and vigour which questions the productivity of stored seed (Copeland, 1988). The maximum vigour index values (1922) were recorded with $1^{st}$ month of evaluation and the lowest (1305) was with $10^{th}$ month after storage. In T X C interaction effect, pink polycoat + Carbendazim + Imidachloprid @ 3 g + 2 g + 2 ml + 5 ml water $kg^{-1}$ of seed treatment recorded the highest (1754), irrespective of the containers. In T X P interaction, at all periods of storage seeds treated with pink polycoat + Carbendazim + Imidachloprid @ 3 g + 2 g + 2 ml + 5 ml water $kg^{-1}$ of seed treatment recorded the highest value. In C X P interaction, at all periods of storage polythene laminated aluminum foil pouches recorded the higher value. The interaction, T X C X P was also highly significant (Table 3).

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**TABLE 1.** Influence of seed storage containers, seed treatments and storage periods on moisture content (%) of female parent LCR 2 tomato hybrid COTH-2

| **Containers (C) / seed treatments (T)** | **Periods of storage in months (P)** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Mean |
| **Polyethylene bags** | | | | | | | | | | | | |
| Control | 7.4 | 7.6 | 7.9 | 8.2 | 8.6 | 8.8 | 9.1 | 9.4 | 9.8 | 10.1 | 10.3 | 8.8 |
| Polymer coating(P) | 7.3 | 7.5 | 7.8 | 7.9 | 8.2 | 8.5 | 8.8 | 9.0 | 9.2 | 9.5 | 9.7 | 8.5 |
| P + Imidachlobrid (I) | 7.2 | 7.4 | 7.5 | 7.7 | 7.9 | 8.1 | 8.4 | 8.7 | 8.8 | 9.0 | 9.4 | 8.2 |
| P+ Carbendazim (C) | 7.3 | 7.5 | 7.7 | 7.9 | 7.9 | 8.1 | 8.3 | 8.6 | 8.8 | 9.1 | 9.4 | 8.2 |
| P + I + C | 7.2 | 7.4 | 7.6 | 7.8 | 7.8 | 8.0 | 8.2 | 8.4 | 8.6 | 8.9 | 9.2 | 8.1 |
| Mean | 7.3 | 7.5 | 7.7 | 7.9 | 8.1 | 8.3 | 8.4 | 8.8 | 9.0 | 9.3 | 9.6 | **8.4** |
| **Plastic containers** | | | | | | | | | | | | |
| Control | 7.4 | 7.6 | 7.8 | 8.1 | 8.3 | 8.6 | 8.9 | 9.1 | 9.4 | 9.6 | 9.9 | 8.6 |
| Polymer coating(P) | 7.4 | 7.5 | 7.7 | 7.9 | 8.1 | 8.3 | 8.5 | 8.7 | 8.9 | 9.2 | 9.4 | 8.3 |
| P + Imidachlobrid (I) | 7.2 | 7.4 | 7.6 | 7.6 | 7.8 | 8.1 | 8.4 | 8.6 | 8.8 | 9.1 | 9.3 | 8.2 |
| P+ Carbendazim (C) | 7.3 | 7.4 | 7.6 | 7.8 | 7.9 | 7.9 | 8.2 | 8.4 | 8.7 | 8.9 | 9.2 | 8.1 |
| P + I + C | 7.1 | 7.2 | 7.3 | 7.4 | 7.6 | 7.8 | 8.1 | 8.3 | 8.4 | 8.7 | 9.0 | 7.9 |
| Mean | 7.3 | 7.4 | 7.6 | 7.8 | 7.9 | 8.1 | 8.4 | 8.6 | 8.8 | 9.1 | 9.4 | 8.2 |
| **Poly laminated aluminium foil pouches** | | | | | | | | | | | | |
| Control | 7.1 | 7.3 | 7.4 | 7.6 | 7.8 | 8.1 | 8.4 | 8.6 | 8.8 | 9.2 | 9.4 | 8.2 |
| Polymer coating(P) | 7.2 | 7.4 | 7.5 | 7.7 | 7.9 | 8.1 | 8.4 | 8.5 | 8.7 | 9.0 | 9.3 | 8.2 |
| P + Imidachlobrid (I) | 7.3 | 7.5 | 7.6 | 7.8 | 8.1 | 8.2 | 8.4 | 8.6 | 8.8 | 8.9 | 9.0 | 8.2 |
| P+ Carbendazim (C) | 7.2 | 7.3 | 7.5 | 7.7 | 7.8 | 8.0 | 8.2 | 8.5 | 8.7 | 8.8 | 9.0 | 8.1 |
| P + I + C | 7.1 | 7.3 | 7.4 | 7.6 | 7.7 | 7.9 | 7.9 | 8.1 | 8.3 | 8.6 | 8.8 | 7.9 |
| Mean | 7.2 | 7.4 | 7.5 | 7.7 | 7.9 | 8.1 | 8.3 | 8.5 | 8.7 | 8.9 | 9.1 | **8.1** |
| **Treatment X Period** | | | | | | | | | | | | |
| Control | 7.3 | 7.2 | 7.7 | 7.9 | 8.3 | 8.5 | 8.8 | 9.1 | 9.5 | 9.6 | 9.9 | **8.5** |
| Polymer coating(P) | 7.3 | 7.5 | 7.7 | 7.8 | 8.1 | 8.3 | 8.6 | 8.8 | 9.1 | 9.2 | 9.5 | 8.4 |
| P + Imidachlobrid (I) | 7.2 | 7.5 | 7.6 | 7.6 | 8 | 8.1 | 8.4 | 8.7 | 8.9 | 9 | 9.3 | 8.2 |
| P+ Carbendazim (C) | 7.2 | 7.4 | 7.6 | 7.7 | 7.9 | 8 | 8.2 | 8.6 | 8.9 | 9 | 9.2 | 8.2 |
| P + I + C | 7.1 | 7.3 | 7.4 | 7.5 | 7.7 | 7.9 | 8 | 8.3 | 8.6 | 8.7 | 9 | **8.0** |
| Mean | **7.2** | 7.4 | 7.6 | 7.7 | 8.0 | 8.2 | 8.4 | 8.7 | 9.0 | **9.1** | 9.4 | 8.2 |

| **Level of significance** | | | | | | | |
|---|---|---|---|---|---|---|---|
| | T | C | P | T X C | T X P | C X P | T X C X P |
| SEd | 0.028 | 0.022 | 0.041 | 0.048 | 0.092 | 0.071 | 0.159 |
| CD | 0.055** | 0.042** | 0.081** | 0.094** | 0.181** | 0.140* | N.S. |

**TABLE 2:** Influence of seed storage containers, seed treatments and storage periods on germination percentage of LCR 2

| Containers (C) / Seed treatments (T) | Periods of storage in months (P) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Mean |
| Polyethylene bag | | | | | | | | | | | | |
| Control | 89 (70.63) | 87(68.8) | 84(66.42) | 82 (64.9) | 81(64.16) | 80 (63.44) | 79 (62.73) | 77 (61.35) | 75 (60.00) | 73 (58.70) | 71 (57.42) | 80 (64.90) |
| Polymer coating (P) | 87 (68.87) | 87 (68.8) | 85 (67.22) | 83 (65.6) | 83 (65.65) | 81 (64.16) | 80 (64.90) | 78 (62.01) | 75 (60.00) | 73 (58.70) | 72 (58.05) | 80 (64.90) |
| P + Imidachlobrid (I) | 88 (69.73) | 86 (68.0) | 86 (68.03) | 84 (66.4) | 83 (65.65) | 82 (64.90) | 82 (64.90) | 80 (64.90) | 79 (62.73) | 78 (62.01) | 76 (60.67) | 82 (64.90) |
| P+ Carbendazim (C) | 90 (71.57) | 88 (69.7) | 88 (69.73) | 85 (67.2) | 84 (66.42) | 83 (65.65) | 81 (64.16) | 79 (62.73) | 76 (60.67) | 74 (59.35) | 72 (58.05) | 82 (64.90) |
| P + I + C | 92 (73.57) | 89 (70.6) | 87 (68.87) | 87 (68.8) | 86 (68.03) | 85 (67.22) | 83 (65.65) | 82 (64.90) | 79 (62.73) | 77 (61.34) | 73 (58.70) | 84 (64.90) |
| Mean | 89 (70.63) | 87 (68.8) | 86 (68.03) | 84 (66.4) | 83 (65.65) | 82 (64.90) | 81 (64.16) | 79 (62.73) | 77 (61.35) | 75 (60.00) | 73 (58.70) | 82 (64.90) |
| Plastic containers | | | | | | | | | | | | |
| Control | 87 (68.87) | 86 (68.03) | 85 (67.22) | 83 (65.6) | 83 (65.65) | 81 (64.16) | 79 (62.73) | 78 (62.01) | 76 (60.67) | 73 (58.70) | 71 (57.42) | 80 (63.44) |
| Polymer coating | 91 (72.55) | 90 (71.57) | 88 (69.73) | 85 (67.2) | 85 (67.22) | 84 (66.42) | 83 (65.65) | 80 (63.44) | 78 (62.01) | 76 (60.67) | 74 (59.35) | 83 (65.65) |
| P + Imidachlobrid (I) | 90(71.57) | 88 (69.73) | 87 (68.87) | 85 (67.2) | 85 (67.22) | 83 (65.65) | 82 (64.90) | 82 (64.90) | 80 (63.44) | 78 (62.01) | 77 (61.35) | 83 (65.65) |
| P+ Carbendazim (C) | 93 (74.66) | 92 (73.57) | 90 (71.57) | 88 (69.7) | 86 (68.03) | 86 (68.03) | 84 (66.42) | 83 (65.65) | 81 (64.16) | 78 (62.01) | 75 (60.00) | 85 (67.22) |
| P + I + C | 89(7 .63) | 88 (69.73) | 89 (70.63) | 88 (69.7) | 86 (68.03) | 85 (67.22) | 83 (65.65) | 83 (65.65) | 82 (64.90) | 81 (64.16) | 79 (62.73) | 85 (67.22) |
| Mean | 90 (71.57) | 89 (70.63) | 88 (69.73) | 86 (68.0) | 85 (67.22) | 84 (66.42) | 82 (64.90) | 81 (64.16) | 79 (62.73) | 77 (61.35) | 75 (60.00) | 83 (65.65) |

Table.2:Contd…

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Poly laminated aluminium foil pouches** | | | | | | | | | | | | |
| Control | 88 (69.73) | 87 (68.87) | 85 (67.2) | 83 (65.65) | 82 (64.90) | 80 (63.44) | 77 (61.35) | 76 (60.67) | 73 (58.70) | 73 (58.70) | 71 (57.42) | 80 (63.44) |
| Polymer coating (P) | 90 (71.57) | 88 (69.73) | 88 (69.7) | 86 (68.03) | 85 (67.22) | 84 (66.42) | 83 (65.65) | 82 (64.90) | 81 (64.16) | 81 (64.16) | 80 (63.44) | 84 (66.42) |
| P + Imidachlobrid (I) | 89 (70.63) | 89 (70.63) | 87 (68.8) | 85 (67.22) | 85 (67.22) | 84 (66.42) | 83 (65.65) | 83 (65.65) | 81 (64.16) | 80 (63.44) | 78 (62.01) | 84 (66.42) |
| P+ Carbendazim (C) | 91 (72.55) | 90 (71.57) | 90 (71.5) | 88 (69.73) | 87(68.87) | 85 (67.22) | 84 (66.42) | 84 (66.42) | 83 (65.65) | 81 (64.16) | 79 (62.73) | 86 (68.03) |
| P + I + C | 93 (74.66) | 91 (72.55) | 91 (72.5) | 89 (70.63) | 88 (69.73) | 88 (69.73) | 86 (68.03) | 85 (67.22) | 84 (66.42) | 82 (64.90) | 80 (63.44) | 87(68.87) |
| Mean | 90 (71.57) | 89 (70.63) | 88 (69.7) | 86 (68.03) | 85 (67.22) | 84 (66.42) | 83 (65.65) | 82 (64.90) | 80 (63.44) | 79 (62.73) | 78 (62.01) | **84 (66.42)** |
| **Treatment X Period** | | | | | | | | | | | | |
| Control | 89 (70.6) | 87 (68.87) | 85 (67.22) | 83 (65.65) | 83 (65.65) | 81 (64.16) | 80 (63.44) | 78 (62.01) | 78 (62.01) | 75(60.00) | 71 (57.42) | **81 (64.16)** |
| Polymer coating (P) | 89 (70.6) | 87 (68.87) | 86 (68.03) | 84 (66.42) | 84 (66.42) | 82 (64.90) | 82 (64.90) | 81 (64.16) | 79 (62.73) | 77(61.35) | 76 (60.67) | 82 (64.90) |
| P + Imidachlobrid (I) | 92 (73.5) | 90 (71.57) | 87 (68.87) | 86 (68.03) | 86 (68.03) | 86 (68.03) | 84 (66.42) | 82 (64.90) | 80 (63.44) | 78 (62.01) | 76 (60.67) | 84 (66.42) |
| P+ Carbendazim (C) | 91 (72.5) | 90 (71.57) | 89 (70.63) | 85 (67.22) | 86 (68.03) | 85 (67.22) | 84 (66.42) | 83 (65.65) | 80(63.44) | 78 (62.01) | 76 (60.67) | 84 (66.42) |
| P + I + C | 89 (70.6) | 88 (69.73) | 87 (68.87) | 85 (67.22) | 85 (67.22) | 84 (66.42) | 83 (65.65) | 82 (64.90) | 81 (64.16) | 80 (63.44) | 78 (62.01) | **84 (66.42)** |
| Mean | **90 (71.57)** | 89 (70.63) | 87 (68.87) | 85 (67.22) | 85 (67.22) | 83 (65.65) | 82 (64.90) | 81 (64.16) | 79 (62.73) | 78 (62.01) | **75 (60.00)** | 83 (65.65) |
| **Level of significance** | | | | | | | | | | | | |
| | T | C | P | T X C | T X P | C X P | T X C X P | | | | | |
| SEd | (0.286) | (0.222) | (0.424) | (0.496) | (0.949) | (0.735) | (1.643) | | | | | |
| CD | (0.562**) | (0.435**) | (0.834**) | (0.974**) | (1.864**) | (1.444**) | N.S. | | | | | |

*Figures in parenthesis indicate arcsine values

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**TABLE 3.** Influence of seed storage containers, seed treatments and storage period on vigour index of LCR 2

| **Containers (C) / seed treatments (T)** | Periods of storage in months (P) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Mean |
| **Polyethylene bag** | | | | | | | | | | | | |
| Control | 1807 | 1792 | 1680 | 1607 | 1547 | 1472 | 1390 | 1324 | 1245 | 1168 | 1101 | 1456 |
| Polymer coating (P) | 1740 | 1836 | 1751 | 1693 | 1652 | 1547 | 1480 | 1404 | 1290 | 1219 | 1174 | 1512 |
| P + Imidachlobrid (I) | 1795 | 1875 | 1823 | 1772 | 1677 | 1591 | 1550 | 1488 | 1406 | 1357 | 1292 | 1591 |
| P+ Carbendazim (C) | 1827 | 1892 | 1830 | 1751 | 1672 | 1594 | 1531 | 1454 | 1360 | 1288 | 1217 | 1583 |
| P + I + C | 1895 | 1967 | 1879 | 1853 | 1780 | 1717 | 1635 | 1583 | 1462 | 1409 | 1292 | 1680 |
| Mean | 1807 | 1862 | 1789 | 1730 | 1652 | 1583 | 1515 | 1446 | 1355 | 1283 | 1219 | **1574** |
| **Plastic containers** | | | | | | | | | | | | |
| Control | 1749 | 1797 | 1717 | 1643 | 1594 | 1515 | 1422 | 1373 | 1315 | 1234 | 1150 | 1496 |
| Polymer coating (P) | 1811 | 1962 | 1857 | 1802 | 1760 | 1680 | 1619 | 1512 | 1420 | 1345 | 1265 | 1635 |
| P + Imidachlobrid (I) | 1836 | 1910 | 1836 | 1794 | 1768 | 1677 | 1624 | 1583 | 1488 | 1404 | 1340 | 1652 |
| P+ Carbendazim (C) | 1925 | 2024 | 1908 | 1866 | 1789 | 1737 | 1655 | 1585 | 1490 | 1404 | 1320 | 1692 |
| P + I + C | 1825 | 1962 | 1931 | 1910 | 1832 | 1760 | 1677 | 1643 | 1566 | 1515 | 1414 | 1726 |
| Mean | 1827 | 1940 | 1848 | 1806 | 1751 | 1672 | 1591 | 1539 | 1446 | 1371 | 1298 | 1635 |
| **Poly laminated aluminium foil pouches** | | | | | | | | | | | | |
| Control | 1778 | 1792 | 1709 | 1643 | 1599 | 1528 | 1448 | 1383 | 1314 | 1285 | 1257 | 1528 |
| Polymer coating (P) | 1791 | 1892 | 1839 | 1806 | 1768 | 1697 | 1652 | 1583 | 1523 | 1507 | 1424 | 1672 |
| P + Imidachlobrid (I) | 1807 | 1931 | 1862 | 1828 | 1785 | 1730 | 1677 | 1643 | 1563 | 1512 | 1427 | 1705 |
| P+ Carbendazim (C) | 1829 | 1953 | 1917 | 1874 | 1827 | 1743 | 1688 | 1655 | 1610 | 1523 | 1454 | 1737 |
| P + I + C | 1907 | 2020 | 1984 | 1940 | 1901 | 1857 | 1789 | 1726 | 1672 | 1599 | 1528 | 1810 |
| Mean | 1818 | 1922 | 1857 | 1806 | 1768 | 1705 | 1660 | 1599 | 1520 | 1477 | 1427 | **1680** |
| **Treatment X Period** | | | | | | | | | | | | |
| Control | 1798 | 1801 | 1709 | 1635 | 1594 | 1523 | 1448 | 1373 | 1349 | 1268 | 1172 | **1507** |
| Polymer coating (P) | 1771 | 1871 | 1789 | 1739 | 1730 | 1648 | 1591 | 1531 | 1446 | 1371 | 1315 | 1607 |
| P + Imidachlobrid (I) | 1877 | 1953 | 1862 | 1832 | 1780 | 1729 | 1655 | 1574 | 1488 | 1404 | 1338 | 1688 |
| P+ Carbendazim (C) | 1856 | 1962 | 1878 | 1794 | 1780 | 1709 | 1638 | 1569 | 1480 | 1412 | 1315 | 1655 |
| P + I + C | 1825 | 1954 | 1888 | 1836 | 1802 | 1747 | 1685 | 1624 | 1547 | 1504 | 1435 | **1714** |
| Mean | 1818 | **1922** | 1827 | 1768 | 1743 | 1660 | 1640 | 1531 | 1454 | 1396 | **1305** | 1635 |
| **Level of significance** | | | | | | | | | | | | |
| | T | | C | | P | | T X C | | T X P | | C X P | T X C X P |
| SEd | 6.845 | | 5.302 | | 10.152 | | 11.855 | | 22.701 | | 17.584 | 39.319 |
| CD | 13.448** | | 10.417** | | 19.947** | | 23.293** | | 44.603** | | 34.550** | N.S |

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