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The efficacy of calcium formulation for treatment of tomato blossom-end rot

(Keberkesanan formulasi kalsium terhadap rawatan reput hujung buah tomato)

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Keywords: blossom-end rot, yield, calcium translocation, calcium supplement, tomato

Abstract

An in-house calcium (Ca) liquid formulation named Camob consisting of a strong and stable Ca chelate to assist in Ca translocation in tomato plants was used to treat blossom-end rot (BER). Two trials were conducted to validate the effectiveness of Camob with and without Ca loading. The effects of concentration, frequency of spraying, spraying on portion of plant bearing fruits and direct spraying on fruits only were evaluated. Results showed that the Camob spray treatments with 1,000 mg/litre Ca loading increased tomato fruit yield (12%) and mean fruit number (16%) in relation to the control. However, there was no significant difference between treatments of Camob at Ca loading of 500 and 1,000 mg/litre with respect to yield, fruit number, average BER incidence and Ca in leaf. BER incidence in Camob and Camob with Ca loading treated plants was reduced significantly to less than one fruit per plant compared to more than three fruits per plant in the non treated plants in the first trial. In the second trial, BER incidence in the treated plants was mostly less than half of the control plants. Foliar application of Camob was not effective in translocating Ca to the first mature leaf at the top of the plant as the increase in the amount of Ca in the leaf was not significant. For reduction of BER incidence, Camob with 500 mg/litre Ca loading can be sprayed directly, once a month, onto the fruit bearing portion of tomato plant one month after transplanting.

Introduction

Blossom-end rot (BER) is a non pathogenic physiological disorder of fruit vegetables particularly in tomato and *Capsicum*. In some years, tomato yield can be affected seriously by BER (Wien and Zhang 1991). In tomato, BER begins as a small watery spot at the distal end of the fruit and becomes obvious as a sunken dark brown scab when the fruit is about 1.0–2.0 cm in diameter. When the fruit becomes larger, cracks begin to appear in the scab leading to secondary infections. However, studies have shown that BER occurred much earlier, generally in the second week after anthesis (Wada et al. 1996; Cho et al. 1998). It does not occur in all trusses of tomato fruit or every fruit in the same truss. Commonly it occurs in fruits situated in the upper truss (Paiva et al. 1998a).

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The relationship between BER and Ca is well established. However, the mechanism by which BER is brought about by Ca deficiency is still poorly understood (Sauce 2001). The major cause has been attributed to imbalance between Ca supply to the distal end of the fruit and demand during rapid fruit enlargement period (Adams and Ho 1993). During rapid enlargement of immature fruit, gibberellic acid level is at the highest causing a decrease in Ca uptake and transport (Wien and Zhang 1991). Indeed, foliar spray of gibberrelic acid was used to induce BER in tomato.

BER is not necessarily due to limitation of Ca uptake from the soil or low Ca in the tissue but it can be affected by Ca transport and deposition. Under rapid transpiration conditions at high temperature and low humidity, Ca is transported in the xylem preferentially to the leaf rather than to the fruit (Ho 1989). Ca deposition as Ca pectate and Ca phosphate in the fruit cell wall is low under all conditions (Ho et al. 1993; Minamide 1993) and adequate supply of Ca is necessary to maintain cell permeability and selectivity (Grattan and Grieve 1999). Ca transport to the distal end of the fruit is also hampered by decreasing number of vascular bundles from the proximal end to the distal end of the fruit (Belda and Ho 1993). When Ca transport is aggravated further by external factors such as high temperature and low humidity which promote rapid transpiration, the requirement for Ca by cell wall and cell membrane in the developing fruits is not being met. Cell membrane begins to weaken resulting in leakage of cell content which leads to secondary infections giving rise to further damage to the fruit.

Another factor that can aggravate Ca nutrition is the excessive use of NH4-N which suppresses Ca uptake (Pill and Lambeth 1980). Large doses of NH4-N application lead to rapid tissue growth resulting in imbalance of Ca supply. Changes in soil moisture, ambient temperature and relative humidly are other external factors affecting Ca transport (Ho 1989). Soil high in salinity which suppresses Ca uptake induced higher BER incidence (Cuartero and Fernandez-Munoz 1998). Genetic susceptibility of cultivars is another contributing factor to BER incidence (Ho et al. 1995).

The physiological aspect of BER is relatively well understood, however, successful control measures are at best sporadic. Traditional treatment strategies are based on moderating growth and prevention or avoidance of sudden change in growing environment. These include mulching (Pill and Lambeth 1980) which reduces large variation in soil moisture changes, avoids high conductivity and provides supplementary Ca during rapid growth period (Tadesse et al. 1999), foliar application of Ca solution (Ho 1999; Schmitz-Eiberger et al. 2002), foliar application of N-K solution (Peyvast et al. 2009), growth inhibitor (daminozide) (Kheshem et al. 1988) and gibberellins inhibitor (uniconazole) (Wui and Takano 1995) during flowering, reducing NH4-N dosage (Pill et al. 1978) and preventing large fluctuations in ambient temperature and humidity (Adams and Ho 1992). All these measures have had some degree of successes but their applications are sometimes difficult, require great skill and expenses.

In view of the prevailing occurrences of BER in fertigated tomato grown under rain shelter in Cameron Highlands, an in-house proprietary Ca formulation was tested to mitigate the problem of BER in tomato. The formulation and its derivatives were evaluated for its effectiveness in enhancing Ca translocation in tomato plant and their effect on incidences of tomato BER in two successive trials.

Materials and methods

Experimental design and treatments

The experiments were conducted during two seasons under netted structures at Cameron Highlands from September 2006 to February 2008. The treatment details are shown in

Tables 1–2. The second season treatments were modified based on findings obtained from the first season trial by concentrating on the higher dose regime and incorporating a commercial Ca foliar preparation for comparison purposes. Treatments were organized under randomized complete block design (RCBD) with 8 treatments replicated 3 times and having 4 monitoring plants per treatment giving a total of 96 monitoring plants.

The second season trial consisted of 6 treatments with 4 replicates and 4 monitoring plants per treatment giving a total of 96 experimental plants, the same number as in the first season trial. One month old seedlings were transplanted into perforated black plastic bags (30 cm x 30 cm dimension) filled with about 1.2 kg of cocoa peat and burnt paddy husk mixture in 1:1 ratio. The plants were spaced 50 cm x 50 cm apart giving a plant density of 25,000

Table 1. Treatments for first season trial

Treatment	Details
T1	Control under fertigation without treatment spray.
T2	Camob (0.1%). Monthly spraying on all leaves and fruits on and below any new fruit truss starting one month after seedling transplant till complete harvest of the 10th truss.
T3	Camob (0.1%). Biweekly spraying on all leaves and fruits on and below any new fruit truss starting one month after seedling transplant till complete harvest of the 10th truss
T4	Camob (0.1%) + Ca 500 mg/litre. Monthly spraying on all leaves and fruits on and below any new fruit truss starting one month after seedling transplant till complete harvest of the 10th truss.
T5	Camob (0.1%) + Ca 500 mg/litre. Biweekly spraying on all leaves and fruits on and below any new fruit truss starting one month after seedling transplant till complete harvest of the 10th truss.
T6	Camob (0.1%) + Ca 1,000 mg/litre. Monthly spraying on all leaves and fruits on and below any new fruit truss starting one month after seedling transplant till complete harvest of the 10th truss.
T7	Camob (0.1%) + Ca 500 mg/litre. Weekly spray on all fruits when at least one fruit in a truss reaching 2 cm in size till one week before harvest and continued until complete harvest of the 10th truss.
T8	Camob (0.1%) + Ca 1,000 mg/litre. Weekly spray on all fruits when at least one fruit in a truss reaching 2 cm in size till one week before harvest and continued until complete harvest of the 10th truss.

Table 2. Treatments for second season trial

Treatment	Details
T1	Control under fertigation without treatment spray
T2	A Ca enhancing commercial brand, application as recommended until complete harvest of the 13th truss.
T3	Camob (0.1%). Biweekly spraying on all leaves and fruits on and below any new fruit truss starting one month after seedling transplant till complete harvest of 13th truss.
T4	Camob (0.1%) + Ca 1,000 mg/litre. Biweekly spraying on all leaves and fruits on and below any new fruit truss starting one month after seedling transplant till complete harvest of the 13th truss.
T5	Camob (0.1%) + Ca 1,000 mg/litre. Monthly spraying on all leaves and fruits on and below any new fruit truss starting one month after seedling transplant till complete harvest of the 13th truss.
T6	Camob(0.1%) + Ca 1,000 mg/litre. Weekly spray on all fruits when at least one fruit in a truss reaching 2 cm in size till one week before harvest and continued until complete harvest of the 13th truss.

plants per hectare. The tomato cultivar used was Batu 163, a popular hybrid favoured by Cameron Highlands tomato farmers. One guard row flanked each side of the monitoring plants. The plants were drip fertigated 3 times a day at 8.00 am, 11.30 am and 3.00 pm using MARDI's fertigation solutions for tomato (Rahman et al. 2003). The fertigation solution contained 200 mg/ litre Ca. Total volume of delivered nutrient solution was one liter per day per plant for the first 2–6 weeks and subsequently increased to 3 liters per day. Standard pest and disease measures and agronomic practices such as leaf pruning were applied.

An in-house proprietary Ca formulation (Camob) using an appropriate Ca chelate with the correct molecular size, stability and solubility was used in the treatments. Camob is designed to assist in Ca translocation within the plant. To produce Camob, organic acid solution was mixed with water at a ratio of 1:12. The solution was kept in very acidic conditions and the pH needs to be moderated using potassium hydroxide (KOH) just before application. Calcium in CaO compound form with a loading of 500 and 1,000 mg/litre was added to Camob in the appropriate treatments with the aim of enhancing the Ca content in the tissues.

Yield monitoring

The number of fruits and weight of each fruit harvested from each fruit truss were recorded. This was also applied to the fruits affected by blossom end rot. Tomato fruits were harvested up to the 10th fruit truss in the first trial in accordance with the current farming practice and up to the 13th truss in the follow-up trial.

Leaf sampling

The immediate leaf adjacent to the fruit on the 5th truss was taken for Ca analysis after the last harvest of the fruits in that particular fruit truss. This was done on each of the monitoring plants before the next treatment spray was due. At the same time, the 4th leaf from the tip of the plant representing newly mature leaf was also sampled for Ca analysis. These leaves did not receive any direct spraying treatments. The leaves were cleaned with a clean muslin cloth and dried in the oven at 60 °C for 48 h. The leaves were then bulked and pulverized to pass a sieve of 100 mesh. One g of the leaf sample was digested in concentrated HNO_3 and HCl (Huang and Schulte 1985). The filtered solution was then analysed for Ca using the Inductively Couple Plasma-Optical Emission Spectrometer (ICP-OES) at MARDI's Analytical and Quality Assurance Laboratory.

Statistical analysis

Data were analysed using analysis of variance (ANOVA) and means separation was performed using the Tukey's Studentized Range (HSD) test. The statistical analyses were carried out using SAS Version 9.1 package (SAS Inst. 2004).

Result and discussion

Yield and fruit number

It is apparent that all spraying treatments (*Table 3*) enhanced tomato fruit yield in relation to the control. Higher fruit yields were obtained in plants treated with treatments 6 and 8 which had the highest Ca dosage at 1,000 mg/litre. The 2 treatments enhanced yield significantly in relation to the control. It is very difficult to increase yield when the base yield was high at 8.03 kg per plant (control). The benchmark for tomato yield at Cameron Highlands is 6 kg per plant. Treatments without any added Ca (T2 and T3) had minimum increase in yield at 2.9% and 4.3% respectively. However, treatments with 500 mg/litre Ca loading sprayed at biweekly (T5) and monthly (T4) intervals did not give a significant difference in yield compared to treatments with Ca loading of 1,000 mg/litre (T6 and T8). Direct spraying of 500 and 1,000 mg/litre Ca on fruits was effective in enhancing fruit yield by 3% and 12% respectively. The yield effect resulting from treatment with 1,000 mg/litre Ca loading suggested that a very

Table 3. Mean yield and number of tomato fruits harvested in the first season trial

Treatment	Yield/plant (g)	Number of fruits
T1	8039.0a	62.0a
T2	8271.3ab	64.3ab
T3	8382.3ab	68.7ab
T4	8320.3ab	67.3ab
T5	8295.0ab	64.7ab
T6	9040.0b	72.3b
T7	8293.7ab	64.7ab
T8	8987.3b	72.3b

Means with the same letter are not significantly different at $p \leq 0.05$

Table 4. Average number of fruits and total fruit weight affected by blossom-end rot in the first season trial

Treatment	Number of BER fruits	Weight (g)
T1	16.0a	1612.4a
T2	3.0b	274.4b
T3	0.3b	35.7b
T4	0.3b	28.3b
T5	0.7b	118.9b
T6	1.7b	113.0b
T7	1.7b	133.4b
T8	0b	0b

Means with the same letter are not significantly different at $p \leq 0.05$

high Ca loading was required for higher yield enhancement. The relatively lower yield in the control treatment was essentially attributed to lesser number of marketable harvested fruits as a result of having the most number of BER fruits (*Table 4*). The mean number of harvested fruits (62) from the control treatment was low in relation to number of fruits from the other treatments. The treatment with a higher dosage of Ca at 1,000 mg/litre which had the highest yield also significantly had the highest mean number of fruits (72) per plant. The number of fruits follows closely with the yield trend which was affected by treatments.

Incidence of blossom-end rot (BER)

The effect of spraying treatment on yield was not dramatic because of the high yield base but treatment effect in minimizing the incidence of blossom-end rot (BER) was very clear (*Table 4*). Practically all the treatments reduced BER significantly to inconsequent levels for the first season trial. The average number of fruits affected by BER in the control plot was 16 (*Table 4*) and 6 (*Table 7*) for the first and second seasons respectively. The other treatments drastically reduced BER incidences from 1–3 fruits. As expected, the treatments which had 500 and 1,000 mg/litre Ca loading was very effective in reducing BER incidence to 1 or 2 fruits only. For the second season trial, biweekly spraying Camob with Ca loading at 1,000 mg/l (T4) significantly reduced BER incidence by 95 % compared to the control (*Table 7*). This shows convincingly the effectiveness of Camob with 500 and 1,000 mg/litre Ca loading in mitigating incidence of BER in tomato.

The total yield loss due to BER in the control plants (T1) was 4.37 kg (*Table 5*) equivalent to 364 g per plant. A majority of BER fruits did grow to marketable size with minimum weight of 55 g per fruit although Dekock et al. (1979) found that BER fruits were generally smaller and matured earlier than the normal fruits. In the first trial, 88.1% of BER affected fruits in the control plants reached marketable size weighing 55–180 g (*Table 5*). This resulted in a potential revenue loss to BER of about RM12,025 based on a planting density of 25,000 per hectare at an ex-farm price of RM1.50 per kg. This revenue loss due to BER can be reduced drastically if treated with Camob with 500 and 1,000 mg/litre Ca loading.

Position of BER affected fruits

As BER is affected by the rate of Ca supply in relation to requirement during rapid fruit expansion, it is reasonable to expect that fruits situated in higher parts of the

Table 5. Truss position of BER affected fruits, total weight and % of BER fruits reaching marketable size in the first season trial

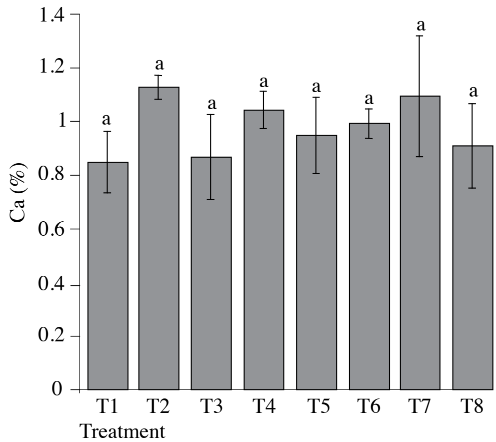
Treatment	Truss position										No. of BER fruits	Weight (kg)	Marketable size (55–180 g) (%)
	1	2	3	4	5	6	7	8	9	10			
T1	0	1	2	2	2	3	5	11	10	6	42	4.37	88.1
T2	0	2	0	0	1	0	1	3	2	0	9	0.82	77.8
T3	0	0	0	0	0	0	0	0	1	0	1	0.11	0
T4	0	0	0	0	0	0	0	1	0	0	1	0.10	0
T5	0	1	0	0	0	0	0	1	0	0	2	0.25	50.0
T6	0	2	1	0	0	0	0	1	0	0	4	0.34	75.0
T7	0	0	0	0	1	0	3	1	0	0	5	0.40	60.0
T8	0	0	0	0	0	0	0	0	0	0	0	0	0.0

plant will be most affected. This is due to the reducing rate of Ca supply because as Ca moves up along the xylem, it is being immobilized by tissues in the lower part of the plants (Aloni 2001; Zavalloni et al. 2001). There is also competition between leaf and fruit during active transpiration (Ho 1989). The result obtained from this trial on position of BER fruits corroborates this thesis (*Table 5*). BER fruits first appeared in the second fruit truss and reached a peak at the 8th to 9th trusses. Beyond the 8th truss, the control treatment continued to show high number of BER incidences. BER affected fruits clustered around the 7th to 9th fruit truss for other treatments. Cho et al. (1998) and Paiva et al. (1998b) also observed that BER fruits increased in successive trusses.

Ca in leaf tissue

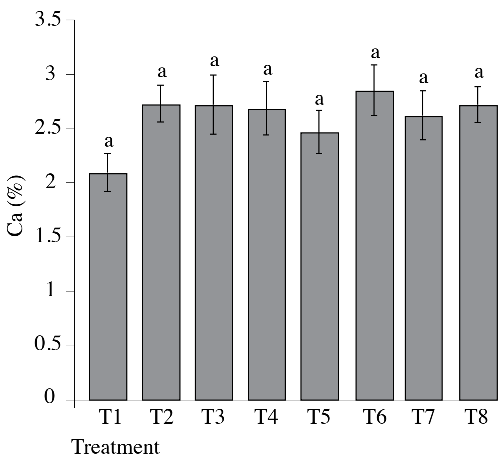
Examining the Ca content in mid-season would give some estimates whether the Camob treatment was effective in translocating Ca as well as increasing tissue Ca content. The effect of Ca loading with Camob treatments in leaf Ca content in the first season trial is shown in *Figures 1–2*. All treatments had induced higher Ca in the upper leaf (4th leaf from the plant tip) than the control although the differences were not significant. Similarly all spray treatments also enhanced Ca in the lower leaf at the 5th truss although treatment differences were again not significant. The lowest Ca content was found in the control while the highest was recorded in plants which were sprayed at monthly intervals with Camob and Ca loading at 1,000 mg/litre (T6). The upper leaf did not receive Camob spraying as all treatment sprays were restricted to the fruit bearing portion of the plant. Since the increase in Ca in the upper leaf was not significant, this clearly indicated that Camob was not effective in translocating Ca higher up the plant.

In the lower leaf, the increase in Ca was also not significant among treatments. Leaf in the 5th truss of the control treatment contained 2.10% Ca which is considered adequate for normal physiological functions in tomato plant (Hochmuth et al. 2004). The highest amount was found in T6 treated plants at 2.86% which also had the highest fruit yield (*Table 3*) and minimal level of BER incidence. However, the amount of Ca in plants treated with Camob and Ca loadings (T4, T5, T6, T7, and T8) is not much different from the leaf Ca content of plants treated with Camob only (T2 and T3). This suggests that the added Ca in spray solution had little effect in enhancing the lower leaf Ca content. It is postulated that when Camob is absorbed into the tissues, it forms soluble Ca chelate which makes the Ca translocatable. The adequate level of Ca in the leaf of the control treatment at 2.10 % and the reduction of BER incidence upon Camob treatments with high Ca loading is in agreement with Ho et al.'s (1993) assertion that BER in tomato is largely attributed to



Means with the same letter are not significantly different at $p \leq 0.05$

Figure 1. Ca content (%) in upper leaves of tomato plant in the first season trial



Means with the same letter are not significantly different at $p \leq 0.05$

Figure 2. Ca content (%) in the 5th truss leaves of tomato in the first season trial

transient imbalance between transport supply of Ca and high demand for Ca during rapid fruit development phase. This imbalance between Ca supply and demand during rapid growth was also known to cause tip-burn in lettuce where the tip-burn disorder was associated with faster development rate under controlled environment compared to field grown plants (Barta and Tibbitts 1991).

Validation of treatment effect on yield and BER incidence

In order to confirm the treatment effects observed in the first trial, a follow-up trial was conducted with treatment modifications based on data observed in the initial trial. Treatments were reduced from 8 to 6, replications increased from 3 to 4 to maintain the same number of 96 monitoring plants. In the second trial, treatments produced non significant yield responses (*Table 6*) as opposed to the first season trial (*Table 3*). Treatment effect on yield was masked by the very high base yield in the control treatment at 9.6 kg/plant. No positive significant treatment effect on yield was observed in the total harvest up to the 10th truss. Extending the harvesting period up to the 13th truss also failed to generate significant yield responses. Although, higher fruit yield was still recorded for T4 and T5 with the highest Ca loading, the difference was not significant. In general, there was a yield difference of about 1 kg per plant for all treatments by extending the harvesting period to the 13th truss. The decision to

Table 6. Mean yield and number of tomato fruits harvested in the second season trial

Treatment	Yield/plant (g)		Number of fruits
	Up to 10th truss	Up to 13th truss	
T1	9598.3a	10444.8a	70.6a
T2	9570.0a	10506.3a	69.1a
T3	9522.8a	10262.3a	71.2a
T4	9858.3a	10796.5a	72.1a
T5	9899.3a	10974.8a	72.2a
T6	9345.8a	10400.0a	70.2a

Means with the same letter are not significantly different at $p \leq 0.05$

extend the harvesting to the 13th fruit truss will depend on the prevailing market price and the productive state of the plant.

The higher yield obtained for the second trial relative to the first trial across all treatments was due to more favourable weather conditions during fruiting period. In the first season trial, active fruiting period was from late September to December 2006 during which the daily sunshine was generally less than 4 h while in the second trial, active fruiting period was from November to February 2008 with daily sunshine ranging from 4 to 6 h. Correspondingly, the mean daily relative humidity was lower in the second trial (80%) while the mean daily relative humidity in the first trial exceeded 90%. Longer sunshine hours and lower humidity is known to promote better crop productivity via higher transpiration (Mulholland et al. 2000).

The incidence of BER was lower in the second trial (*Tables 7–8*). In the control treatment, total number of BER affected fruits was markedly lower at 20 fruits up to the 13th fruit truss from 12 plants (*Table 8*) as opposed to 42 BER affected fruits from 16 plants up to the 10th truss in the first season trial (*Table 5*). This means that on the average, less than one fruit per plant was affected by BER and this largely explains the reason for the indifferent responses on yield upon treatments in the second trial. A large proportion of BER fruits occurred in the second truss (*Table 8*) as opposed to the first trial (*Table 5*) where BER fruits were found higher up in the plant. In the control, BER fruits occurred regularly in the fruit trusses while only sporadically for other treatments. In addition, the mean number of harvested fruits per plant varies very little from 69 to 72 (*Table 6*) which was higher than the mean number of fruits harvested per plant ranging from 62 to 72 in the first trial. The higher number of fruits accounts for the higher yield in the follow-up trial. However, the control treatment still had the highest incidence of BER fruits. This again illustrates the beneficial effect of Camob with or without Ca loading spray in reducing BER incidence. A commercial Ca brand (T2) was equally effective in reducing BER but fruit yields were lower. Camob treatment, with 1,000 mg/litre Ca loading once every 2 weeks (T4), produced a single BER fruit which was significantly different from the control. The less severe BER incidence in the second trial is attributed to better growing conditions.

In view of the Camob ability to reduce BER incidence in tomato, it may be useful in treating other physiological disorders

Table 7. Average number of fruits and total fruit weight affected by blossom-end rot in the second season trial

Treatment	Number of BER Fruit	Weight (g)
T1	6.0a	871.8a
T2	2.8ab	591.3ab
T3	2.0ab	217.3ab
T4	0.3b	18.4 b
T5	2.3ab	523.0 ab
T6	2.3ab	547.2 ab

Means with the same letter are not significantly different at $p \leq 0.05$

Table 8. Truss position of BER affected fruits in the second season trial

Treatment	Truss position/fruit number													Total BER fruits
	1	2	3	4	5	6	7	8	9	10	11	12	13	
T1	0	4	1	1	2	0	1	0	3	3	2	0	3	20
T2	0	4	0	1	0	0	2	0	1	0	0	0	2	10
T3	0	4	0	0	0	0	1	0	1	1	1	0	0	8
T4	0	0	0	0	0	0	0	0	0	0	0	1	0	1
T5	0	5	0	0	1	0	1	1	0	1	0	0	0	9
T6	0	2	1	1	1	0	0	1	1	2	0	0	0	9

largely due to Ca deficiency. These include BER in sweet pepper (*Capsicum annuum* L), chilli fruit end rot, heart rot in mango, sapodilla, chinese cabbage, tip-burn in lettuce and cole crops and fruit splitting phenomena in mango, citrus and dokong. It may also be useful in strengthening the skin of starfruit against bruising.

Conclusion

The in-house proprietary Ca formulation, Camob, is effective in minimizing incidence of BER in tomato fruit to inconsequent levels. Camob is recommended to be applied with 500 mg/litre Ca loading and sprayed at monthly intervals directly onto the fruit bearing portion of the plant, one month after transplanting.

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Abstrak

Formulasi cecair Ca (Camob) yang dihasilkan di makmal melalui pengkelet Ca yang kukuh dan stabil bagi membantu pemindahan kalsium dalam pertumbuhan pokok tomato telah digunakan untuk merawat penyakit reput hujung buah (BER). Dua percubaan telah dijalankan untuk mengesahkan keberkesanan Camob dengan atau tanpa muatan Ca. Kesan kepekatan, kekerapan semburan, semburan pada bahagian pokok yang mengeluarkan buah dan semburan terus ke atas buah telah dinilai. Keputusan menunjukkan rawatan semburan Camob dengan 1,000 mg/liter muatan Ca meningkatkan hasil tomato (12%) dan purata jumlah buah (16%) berbanding dengan kawalan. Walau bagaimanapun, tidak terdapat perbezaan yang ketara antara rawatan Camob dengan muatan Ca sebanyak 500 dan 1,000 mg /liter dari segi hasil, bilangan buah, purata insiden BER dan kandungan Ca dalam daun. Dalam percubaan pertama semburan Camob (dengan/tanpa muatan Ca) mengurangkan BER secara signifikan kepada satu buah setiap pokok berbanding dengan lebih tiga buah setiap pokok tomato yang tidak dirawat. Bagi percubaan kedua, separuh daripada insiden BER pada pokok yang dirawat dapat dikurangkan berbanding dengan pokok kawalan. Semburan Camob pada daun didapati tidak berkesan memindahkan Ca kepada daun matang pertama kerana peningkatan kandungan Ca di dalam daun tidak signifikan. Untuk mengurangkan insiden BER, Camob dengan 500 mg/liter muatan Ca boleh disembur secara langsung, sebulan sekali, ke bahagian pohon yang mengeluarkan buah satu bulan selepas mengubah.

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