Enhancing Phytosanitary Systems for Healthy Plants, Safe & Sustainable Trade”

Sub-theme:

Industry role in implementation of successful phytosanitary systems

Title:

Evaluation of Periphos 77.5 GR in Fumigation of Roses for Management of Thrips (*Frankliniella Occidentalis*), Red Spider Mites (*Tetranychus Urticae*) and False Codling Moth (*Thaumatotibia Leucotreta*)

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Introduction

- Flowers (roses, carnations and summer flowers) are major horticultural produce in Sub-Saharan Africa (Adom *et al.*, 2020)
- In Kenya, the flower industry is the third largest flower exporter in the World and is the country's top foreign exchange earner (Azizi, 2019; Tyce, 2020)
- Flower exports to EU from Kenya were valued at over Ksh.113 billion (USD 1.027 billion) in 2018 (HCDA, 2019)
- Among biotic constraints include insect pests and mites of phytosanitary importance that have been intercepted by EU member states and other countries (Adom *et al.*, 2020).

Introduction cont’

- The common insect pests and mites of significance are:
  - False codling moth (*Thaumatolibia leucotreta* Meyrick), western flower thrips *(Frankliniella occidentalis* Pergande*)* (Thysanoptera: Thripidae) and red spider mite *(Tetranynychus urticae* Koch*)* (Acari: Tetranychidae)
- False codling moth (FCM) is a quarantine pest attacking over 70 documented host plants including rose flowers (Mkiga *et al.,* 2019)
- Red spider mite is extremely polyphagous species that pose a threat to horticultural crops like flowers (Bolland *et al.,* 1998)
- Thrips attack a wide range of host plants in both field and greenhouses (Mound, 2013; Dlamini *et al.,* 2019)

Problem Statement

- Chemical control is widely practiced BUT resistance by these pests to many insecticides due to overuse limits their effective control (Dlamini *et al.*, 2019)

- Post-harvest management of these pests (thrips, mites and FCM) is effected through fumigation

- Currently, the most effective method is use of methyl bromide (MB), which has been classified as a compound with ozone-depleting potential

- In horticultural products, it causes serious phytotoxic damage to cut flowers thus impacts on the value and shelf life of the produce (Zhang *et al.*, 2012; Kim *et al.*, 2016).

Justification

- Therefore, there is an urgent need to search for alternatives to this fumigant that are environmentally safe
- An effective fumigant must be volatile enough to produce a toxic concentration in a closed space in a short period of time
- Whereas aluminium phosphide 56% formulation is commercially available, its potential in phytosanitary FCM disinfestation of cut flowers is less practiced
- Reason: It takes three to ten days to decompose depending on the ambient temperatures
- There is need therefore to test newer aluminium phosphide formulation for fumigation against insect pests without damaging the cut flowers

Objectives

- ➢ To test the efficacy of Periphos for postharvest fumigation for disinfesting Kenyan flowers destined for export
- ➢ To evaluate the phytotoxicity of Periphos fumigation to flowers

Methodology

- This trial was carried out in Subati flower farm in Naivasha Sub County at 0.7049528 S and 36.49118507 E at an altitude of 2202 meters above sea level in Nakuru County, Kenya
- Average daily ambient temperatures were between 24.2 and 28.1°C; average night temperatures were between 17.3 and 21.7 ^{0}C
- This trial was conducted from January 6th to 22nd, 2020 in a modified container to provide temperatures of 8 - 10 ^{0}C and 2.5 - 4 ^{0}C
- Aluminium phosphide granules were used to generate phosphine gas at concentrations of 500 1000, 1500, 2000 and 3000 ppm by use of QuickPHIo-R® phosphine generator
- The gas was generated in 60 minutes for the laboratory model generator.

Methodology cont'

- Test phosphine concentrations were maintained in fumigation chambers (6.125 Litres capacity) with flowers infested by thrips, mites and FCM for four (4), eight (8), twelve (12), sixteen (16), twenty four (24) and forty eight (48) hours
- Temperatures regimes of ambient (average daily temperatures of 24^{o}C to 28.1^{o}C; night temperatures of 17^{o}C to 21^{o}C), 8-10^{o}C and 2.5–4 ^{o}C were used
- Six flower heads, stems with leaves in each chamber and replicated thrice for each treatment and a control (un-fumigated six flowers heads with stems with leaves) placed in buckets of similar capacity as chambers with adequate quantity of water
- Two trial runs were made

Results

Table 1: % pest mortality in Fumigated and Control treatments

Treatment	Thrips	Mites	FCM
Fumigated	99±0.19	83±2.44	62±3.76
Control	2±0.19	3.1±2.44	2.6±3.76
t-value	15.88	15.05	11.08
df	233	229	177
p-value	< 0.001	< 0.001	< 0.001

Table 2: Effects of phosphine gas concentrations on pest (thrips, mites & FCM) mortality

Concentration_PPM	Thrips	Mites	FCM
500	98.44±0.29	75.73±4.42	0±12.77
1000	98.74±0.29	81.60±4.42	68.24±7.59
1500	99.47±0.36	84.78±5.54	66.22±9.03
2000	99.39±0.36	87.41±5.54	63.89±9.03
3000	99.81±0.56	99.82±8.47	66.49±4.83
LSD	1.064	16.21	24.98
%cv	1.68	30.62	50.5
p-value	0.058	0.12	<.001

Results cont’

Table 3: Effects of fumigation time on pest (thrips, mites & FCM) mortality

Fumigation time_Hrs	Thrips	Mites	FCM
4	99.55±0.37	96.08±5.17	25.08±8.65
8	99.17±0.37	85.99±4.13	80.83±5.07
12	99.00±0.69	43.02±9.68	72.22±17.31
16	98.24±0.40	83.93±5.59	65.16±8.65
24	98.87±0.27	79.03±3.80	52.17±6.12
48	-	-	44.44±17.31
LSD	1.171	16.45	31.31
%cv	1.71	28.58	48.39
p-value	0.173	<.001	<.001

Table 4: Effects of temperature on pest (thrips, mites & FCM) mortality

Temperature (^{0}C)	Thrips	Mites	FCM
10	98.70±0.24	84.45±2.85	54.20±6.36
4	98.78±0.34	53.74±4.15	63.16±10.05
Ambient	99.45±0.26	97.85±3.14	66.60±5.08
LSD	0.7918	9.561	20.73
%cv	1.7	24.52	56.19
p-value	0.089	<.001	0.315

Results cont'

Table 5: Mean percent mortality for FCM (*Thaumatotibia leucotreta*) after fumigation with phosphine at different dosages for different fumigation duration in Subati farm at Naivasha between January 6th and 22nd, 2020.

Temperature (Degrees celcius)	Concentration (PPM)	Treatment	Fumigation exposure(HRS)	% mortality FCM
2.5-4	3000	Fumigation	16	66.7
2.5-4	3000	Control	16	6.7
2.5-4	3000	Fumigation	24	57.8
2.5-4	3000	Control	24	0
8-10	2000	Fumigation	48	66.7
8-10	2000	Control	48	0
8-10	2000	Fumigation	24	16.7
8-10	2000	Control	24	0
8-10	3000	Fumigation	12	66.7
8-10	3000	Control	12	16.7
8-10	3000	Fumigation	24	60
8-10	3000	Control	24	0
8-10	3000	Fumigation	16	63.2
8-10	3000	Control	16	6.7
8-10	3000	Fumigation	24	63.9
8-10	3000	Control	24	5.6

Results cont’

Temperature (Degrees celcius)	Concentration (PPM)	Treatment	Fumigation exposure(HRS)	% mortality FCM
20-28	1500	Fumigation	4	29.4
20-28	1500	Control	4	0
20-28	1500	Fumigation	8	38.1
20-28	1500	Control	8	0
20-28	3000	Fumigation	8	60
20-28	3000	Control	8	0
20-28	1500	Fumigation	8	98
20-28	1500	Control	8	2.1
20-28	2000	Fumigation	8	97.4
20-28	2000	Control	8	3.6
20-28	1000	Fumigation	8	100
20-28	1000	Control	8	0
20-28	3000	Fumigation	8	100
20-28	3000	Control	8	5.9

Conclusion

- Percent mortality for mites was very low at low temperatures
- Thrips were highly managed at all temperatures, exposure time as well as at different fumigant concentrations
- FCM mortality was highly affected by fumigation time as well as fumigant concentration
- There was lower performance of phosphine gas in management of these pests at lower temperatures
- could be associated with lower respiratory activity of the pests at these temperatures
- At low temperatures, exposure time played a critical role in the increase of percent mortality of the pests

Recommendations

- For purposes of cutting costs of the product (aluminum phosphide), lower doses of 1000 and 1500 ppm are highly recommended as the most feasible and could be done for eight hours duration at ambient temperatures

However, recommendations for each specific pest are as follows:

Pest	Fumigation temperature (degrees Celsius)	Fumigant concentration (PPM)	Fumigation duration (exposure) (Hrs)
Thrips	2.5–4	1500	12
	8–10	1500	8
	20–28 (ambient)	500	4
Mites	2.5–4	2000	24
	8–10	1500	16
	20–28 (ambient)	1500	4
FCM	20–28 (ambient)	1000	8

Acknowledgements

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