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Evaluation of suitable technique and determination of appropriate stage of flower for sampling of thrips, *Scirtothrips dorsalis* hood (Thysanoptera: Thripidae) in rose flowers

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Abstract
To confirm whether widely followed beating method is relatively effective and efficient over other available methods viz., Liquid Detergent Method and Turpentine vapour method, the present laboratory study was conducted. The most popular rose variety, Gladiator which the farmers usually cultivate was selected for this study. The four stages of flowers *viz.*, (a) Unopened young buds (2-5 days old) (b) Young buds with calyx opened (6-10 days old) (c) Matured Flowers (1-5 days old) (d) Fully opened flowers (>5 days old) were used for thrips extraction. The beating method (BM) proved to be the most effective method for extraction of thrips (both larvae and adult) where in mean efficacy was 82.77% followed by liquid detergent method (LDM) where in the mean efficacy was 74.20%. The turpentine vapour method (TVM) recorded the least mean efficacy of 62.31%. When mean efficacy of extraction of thrips was compared between the flower stages during sampling, it was high on matured flowers (78.76%), followed by fully opened flower (71.84%), calyx opened bud (62.44%) and young bud (58.10%). Beating method of extraction of thrips from matured flowers recorded higher efficiency (87.52%), followed by fully opened flower (82.62%), calyx opened bud (81.50%) and young bud (79.40). Turpentine vapour method recorded the least efficiency in all aged group of flowers. When we compared interaction effects between different stages of flowers and extraction methods, beating and liquid detergent method recorded higher efficacy for matured and fully opened flowers (87.57%, 82.62%, respectively in BM and 79.29%, 73.58% in LDM, respectively). When time efficiency was compared for extraction of thrips under each method, beating method was found more quick with least mean extraction time (22.2 minutes) compared to turpentine vapour method (154 minutes) and liquid detergent method (38.2 minutes).

Keywords: Thrips, *Scirtothrips dorsalis*, evaluation, sampling methods, flower stages

1. Introduction

Roses (*Rosa* spp.), the Queen of flowers ranks first among the top ten cut flowers in the international flower market and they are valued for their beautiful and often fragrant blooms and have been cultivated in gardens for centuries as vines, shrubs, specimen plants, groundcovers and container plants [4]. Large number of insects attack different parts of rose plants at every stage of growth. Among these pests, the sucking pest, thrips, *Scirtothrips dorsalis* Hood (Thysanoptera: Thripidae) is one of the serious pests of roses [1, 10, 11]. The larvae and adults of *S. dorsalis* cause damage to all the stages of flower which cause 28-95% damage. To estimate the population in the rose, there are different methods of extraction of thrips [12, 5]. used turpentine vapour for extracting thrips from rose flowers [15]. reported that washing in a detergent solution was more efficient than irritation method [7]. designed an apparatus for extraction of thrips from flower using turpentine vapour [6]. used a mechanical method for extracting thrips from rose flowers. The experimental flowers were placed in a plastic container with bottom removed and placed with 16-mesh aluminum window screen and shaken over a moist cloth. The thrips falling on the moistened cloth were counted. [14] reported that the different methods used to estimate the number of thrips on plants fell into three basic categories: (1) Washing methods whereby thrips are removed from the plants with a liquid, (2) Mechanical methods that knock thrips off the plants and (3) Irritation methods that rely upon the vapours of chemical or on heat to drive the thrips off the plant [12].

Compared the methods described by Evans (1933) [15], and [6] (1964), and the wash method of using detergent solution was significantly superior to other methods [2] and [13]. reported that the flower shoot was beaten against black board sheet and thrips, *S. dorsalis* on the black sheet were counted [9]. compared three sampling methods viz., liquid detergent method, turpentine vapour method and beating method of extraction of thrips from rose flowers for four stages of rose flowers viz., unopened buds, calyx opened young buds, harvestable flowers and fully opened flowers. Among the three methods compared for making per cent efficiency estimates, the liquid detergent method (84.13, 85.47 and 85.04%), followed by beating method (82.08, 80.68 and 80.94%) recorded higher efficiency for the extraction of adults, larvae and total population of thrips, respectively from rose flowers [9]. The per cent efficiency of extraction of adults, larvae and total population of thrips present at the time of sampling was high on harvestable flowers (79.44, 79.32 and 79.21%) and fully opened flowers (77.0, 75.73 and 75.78%). The interaction effect between the method of extraction and the stages of flowers showed significantly higher efficiency of extraction of thrips for beating and liquid detergent methods for harvestable and fully opened flowers. The present study revealed that the ideal flower stage for thrips sampling is the harvestable flowers. In terms of extraction, the liquid detergent and beating methods were at par. However, in terms of ease of use and quicker results, beating method was recommended as the ideal method for determining the thrips inside rose flowers [3]. evaluated a method for estimating densities of western flower thrips, *Frankliniella occidentalis* (Pergande) (Thysanoptera: Thripidae), one of the most damaging insect pests of greenhouse cucumber, *Cucumis sativus* L. and rose, *Rosa x hybrida* crops in south eastern France. This method was based on the abundance classes of thrips observed on sampling units of flowers and foliage during a period of <1 min. Classes were calibrated using actual counts and precision was improved by introducing additional predictive variables into multivariate nonparametric regression models. Regression models using infestation variables with and without climatic variables significantly increased calibration precision and made possible the accurate description of population dynamics. Rapid visual scouting methods could be combined for surveys of different pests and diseases. When calibrated, they provided growers or technicians with accurate tools for guiding crop protection decisions. Review tinthe old works, it was found essential to find out which is the best method for extraction of thrips. Hence, to find out the most effective and efficient methods of thrips extraction and the most suitable stage of the flowers for effective sampling, the present study on "Evaluation of suitable technique and determination of appropriate stage of flower for sampling of thrips, *Scirtothrips dorsalis* Hood (Thysanoptera: Thripidae) in rose flowers" was conducted during 2008-09.

2. Materials and Methods

"Evaluation of suitable technique and determination of appropriate stage of flower for sampling of thrips, *Scirtothrips dorsalis* Hood (Thysanoptera: Thripidae) in rose flowers" was conducted during 2008-09 to find out the most appropriate and efficient extraction methods and stage of the flowers for sampling thrips.

2.1 Relative efficacy and efficiency of thrips extraction methods

Normally, method for estimating numbers of thrips is through gentle beating the affected part on to a contrasting coloured boards and counting the dislodged thrips from the sheet. However, nature of feeding of the thrips is by remaining in between the petals of flowers or beneath the calyx, so thrips remaining inside the concealed petals or calyx may not be dislodged by gentle beating. So density count may not be that accurate. Hence, it is necessary to compare other methods employed in estimation of thrips density to see the accuracy of the methods. A laboratory experiment was conducted to determine the efficacy and efficiency of three methods of thrips extraction on rose flowers following [15], [7] and [2]. The most popular rose variety, Gladiator which the farmers usually cultivate was selected for this study. The four stages of flowers *viz.*,, (a) Unopened young buds (2-5 days old) (b) Young buds with calyx opened (6-10) (c) Matured Flowers (1-5days old) (d) Fully opened flowers (>5 days old) were used for thrips extraction. Ten flowers from each stage were picked and used for extraction to compare the efficacy of extraction methods.

2.2 Beating method

This method was similar to the method proposed and used by Bagle (1993). In this method, the infested rose flowers were beaten five times on a contrasting black cardboard sheet and thrips numbers were counted. The thrips which were not dislodged during beating were also counted to estimate the total number of thrips per flower. The efficacy of the method was computed as

$$\text{Extraction efficacy (\%)} = \frac{\text{Harvested thrips}}{\text{Total Thrips}} \text{ X } 100$$

The efficacy of extraction methods was analyzed statistically by adopting 3X4 factorial ANOVA. Time taken was also recorded to know the efficiency of this method.

2.3 With liquid detergent method

The rose flowers of different stages were collected from the fields and transferred in polythene bags (20x26cm). They were immediately tied with a rubber band. In the laboratory, these flowers were torn apart and placed in 0.1 per cent detergent solution in a beaker (13cmx9cm) and stirred for 10 minutes to dislodge the thrips. Then the mixture was allowed to stand for five minutes until most of the thrips settled to the bottom of the beaker. After 10 minutes, floral parts and other plant material were skimmed. Thrips were counted by placing the beaker over contrasting background. The unharvested thrips which were present along with the skimmed material were also counted, to estimate the total number of thrips [15]. The efficacy of the method was measured as

$$\text{Extraction efficacy (\%)} = \frac{\text{Harvested thrips}}{\text{Total Thrips}} \text{X } 100$$

The efficacy of extraction methods was analyzed statistically by adopting 3X4 factorial ANOVA. Time taken was also recorded to know the efficiency of this method.

2.4 Turpentine vapour method

In this turpentine vapour method, a plastic bottle with wide mouth was taken with a lid at the top and the bottom was cut opened and attached to a perforated plate. In the center of the lid a cotton wool was fixed from inside. The container was tightly placed on a funnel whose bottom tip was immersed in

a beaker (13cmx9cm) containing detergent solution. The cut end of the bottle was tightly packed with the cotton with funnel to avoid thrips escape. The cotton wool was moistened with a few drops of turpentine. Flowers infested with thrips were placed in the plastic container (13cm x 9cm). Thrips inside the flowers were repelled by the turpentine vapour and fell into the detergent solution. After 2 hours, the thrips collected from the detergent solution were counted as in liquid detergent method. The thrips, which were not extracted and remained in the flower even after the treatment, were counted to estimate total number of thrips [7]. The efficacy of the method was measured as

$$\text{Extraction efficacy (\%)} = \frac{\text{Harvested thrips}}{\text{Total Thrips}} \text{X } 100$$

2.5 Statistical analysis

The efficacy of extraction methods was analyzed statistically by adopting 3X4 factorial ANOVA. Time taken was also recorded to know the efficiency of this method. All the three methods were compared for the efficacy and efficiency.

3. Results

3.1 Relative efficiency and efficacy of thrips extraction methods

The results of the efficacy and efficiency of different extraction methods are presented in Table 1.

The beating method (BM) method proved to be the most effective method for extraction of thrips (both larvae and adult) where in mean efficacy was 82.77% followed by liquid detergent method (LDM) where in the mean efficacy was 74.20%. The turpentine vapour method (TVM) recorded the least mean efficacy of 62.31%.

When mean efficacy of extraction of thrips was compared between the flower stages during sampling, it was high on matured flowers (78.76%), followed by fully opened flower (71.84%), calyx opened bud (62.44%) and young bud (58.10%).

Beating method of extraction of thrips from matured flowers recorded higher efficiency (87.52%), followed by fully opened flower (82.62%), calyx opened bud (81.50%) and young bud (79.40). Turpentine vapour method recorded the least efficiency in all aged group of flowers.

When we compared interaction effects between different stages of flowers and extraction methods, beating and liquid detergent method recorded higher efficacy for matured and fully opened flowers (87.57%, 82.62%, respectively in BM and 79.29%, 73.58% in LDM, respectively).

When time efficiency was compared for extraction of thrips under each method, beating method was found more quick with least mean extraction time (22.2 minutes) compared to turpentine vapour method (154 minutes) and liquid detergent method (38.2 minutes).

Table 1: Relative efficacy and efficiency of three methods of extraction of thrips on rose

Stage of the flower	Percent thrips extracted				Extraction Time (mins.)			
	BM	TVM	LDM	Mean	BM	TVM	LDM	Mean
Young Bud	79.40 (63.00)	58.05 (49.63)	67.46 (55.22)	58.10 (55.95) [d]	15.8	137	35.4	62.7
Calyx Opened Bud	81.50 (64.53)	62.46 (52.21)	76.45 (60.97)	62.44 (59.24) [c]	19.8	160	37.6	72.5
Matured Flower	87.57 (69.36)	69.42 (56.43)	79.29 (62.93)	78.76 (71.57) [a]	26	159	47	77.2
Fully Opened Flower	82.62 (65.36)	59.32 (50.37)	73.58 (59.07)	71.84 (59.60) [b]	21	152	39.6	70.9
Mean	82.77[a] (65.56)	62.31[c] (52.12)	74.20[b] (59.55)		22.2	154	38.2	71.3
						S. Em. ±	C.D at 1%	C.D.at 5%
Methods of Extraction						0.05	0.197	0.147
Flower Stages						0.05	0.170	0.127
Stages X Methods						0.28	0.341	0.255

TVM- Turpentine Vapour Method LDM- Liquid detergent Method BM- Beating Method

Figures in the parentheses indicate √x+1 transformation

4. Discussion

4.1 Relative efficiency and efficacy of thrips extraction methods

To know the efficacy and efficiency of the available method for thrips extraction, the present study was conducted. Beating method (BM) proved to be the most effective method for extraction of thrips where in mean efficacy was 82.77% followed by liquid detergent method (LDM) where mean efficacy was 74.20%. The turpentine vapour method (TVM) recorded the least mean efficacy of 62.31%. This result is in confirmation with the results of [15] wherein he reported that extraction of thrips by turpentine vapour method is inefficient. [12] and [8] reported that liquid detergent method, followed by beating method was efficient over turpentine vapour method. However, in this study beating method was found superior over other methods (Fig.1). Even though old review opined liquid detergent method was most effective, but when it was tested, it was found that in liquid detergent method, the extracted thrips were again used to stick to the flower petals, hence giving less count.

Beating method of thrips extraction from matured flowers recorded higher efficiency (87.52%), followed by fully opened flower (82.62%), calyx opened bud (81.50%) and young bud (79.40). Since the petals in matured and fully opened flowers are loosely arranged, hence they supported lodging and dislodging of more thrips. In young unopened buds and calyx opened buds, petals are tightly packed which restricted the movement and lodging or loading of thrips.

When mean efficacy of extraction of thrips was compared between the flower stages during sampling, it was high on matured flowers (78.76%), followed by fully opened flower (71.84%), calyx opened bud (62.44%) and young bud (58.10%).

When interaction effects between different stages of flowers and extraction methods were compared, beating and liquid detergent methods recorded higher efficacy for matured and fully opened flowers (87.57%, 82.62%, respectively in BM and 79.29%, 73.58% in LDM, respectively). In turpentine vapour method, thrips were not extracted effectively, since thrips got stuck to the apparatus or to the flowers. This result is in confirmatory with [8].

When efficiency was compared for extraction of thrips under each method, beating method was found more efficient with least mean extraction time (22.2 minutes) compared to liquid

detergent method (38.2 minutes) and turpentine vapour method (154 minutes). Hence, with respect to both efficacy and efficiency, beating method proved more efficient as compared to liquid detergent and turpentine method (Fig.2).

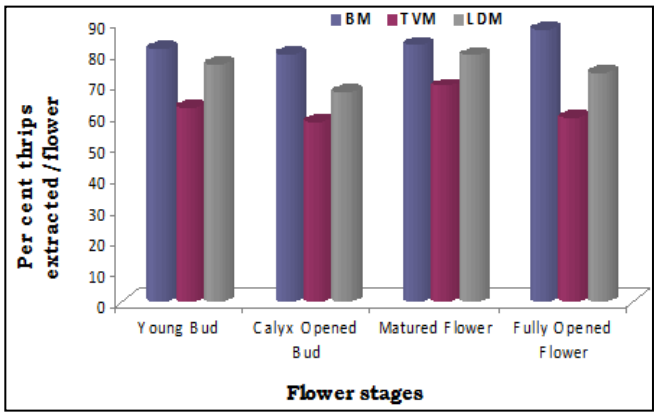

Fig 1: Relative efficacy of three methods of extraction of thrips on rose

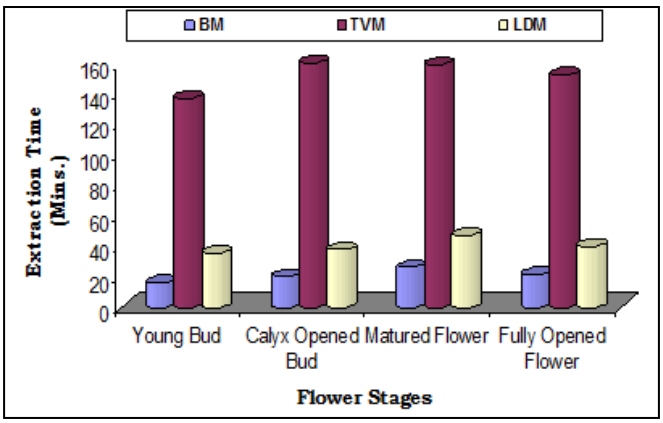

Fig 2: Relative efficiency of three methods of extraction of thrips on rose

5. Conclusion

Among different methods of thrips extraction, beating method was found most effective and efficient (per cent efficacy was 87.52 and time taken was 22.2 minutes). Beating method of thrips collection from matured flowers recorded higher efficiency (87.52%), followed by fully opened flower (82.62%), calyx opened bud (81.50%) and young bud (79.40).

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