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Evaluation of Colored Sticky Traps for the Monitoring of *Tuta absoluta* Meyrick (Lepidoptera: Gelechiidae) in Tomato under Glasshouse in Ethiopia

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Abstract

Tomato crop is considered one of the most economic horticultural crops threat to Ethiopian tomato production. Since tomato leaf miner, *Tuta absoluta*, is a neotropical tomato crops in the world. The population number of *Tuta absoluta* caught on sticky trap colors were evaluated under glasshouse conditions during 2016 to 2017. Each trap was baited with sticky substances on various trap colors. White and blue sticky traps caught more moths than yellow, green and red traps. Significant differences between mean catches by white traps and other colored traps were recorded. Mean number of *T. absoluta* moths caught on yellow, green and red trapped that statistically at par with each other at vegetative stages while a significant lower number of *T. absoluta* moths were trapped on red and green in both years. Hence white and blue sticky traps were preferable for the monitoring of *T. absoluta* moths under glasshouse conditions and then used as one of the effective IPM strategy for monitoring this insect pest.

Keywords: Sticky trap; Capture; Tomato; Color; *Tuta absoluta*; Phonological stage

Introduction

Tomato is one of economically important and widely grown vegetable crop as annual both in the rainy and dry seasons for their fruits by smallholder farmers and commercial state and private farms in Ethiopia [1,2]. It is also a source of basic raw material required for fresh consumption and local processing industry for the production of processed tomato like tomato paste, tomato juice and etc [3].

Tomato production faces many problems from several causes among various factors responsible for low yield of tomato, insect pests are the most important. There are several insect species feed on tomato among of these in recent year, a new insect pest known as tomato leaf miner, *Tuta absoluta* is important tomato pests in Ethiopia [4]. *T. absoluta* was reported in several Middle East countries [5]. This pest causes a very high level of damage to tomato crops [6,7], particularly if no control measures are adopted [5]. *T. absoluta* reduce yield and fruit quality of tomato grown in green house and open field. Severely attacked tomato fruits lose their commercial value, 50-100% losses have been reported on tomato (EPPO, 2005).

Pest control tactics are frequently based on different sticky trap catches as a cultural control measures. Insects are differentially attracted to colored surfaces, particularly yellow as a general insect attractant; a feature exploited among entomologists for collection of Coleoptera, Hemiptera, Hymenoptera and Thysanoptera [8]. But few studies were conducted in Diptera and Lepidoptera insects. Successful population monitoring is important for effective implementing insect control strategies, for properly timing control applications, and for assessing their effects [9]. Sticky traps have been widely used to sample harmful and beneficial insects in wild and cultivated plants worldwide. Traps based on the response of insects to color have been widely used in integrated pest management programs in diverse cultivated crops [10].

Different color preferences of *T. absoluta* have been yet not studied to assess efficacy in different color attraction. Sticky trap efficacy may depend on where traps are placed in relation to crop phenology. Trap height also is important for mass trapping and monitoring insect populations [11]. In this study, we compared

the relative trapping efficiency of different sticky traps colors for tomato leaf miner known as *T. absoluta* at three developmental stages (vegetative, flowering and fruit setting) of tomato. This information was improved monitoring of this pest in tomato and enhance integrated pest management programs. Therefore, the objective of this study was to evaluate different color preference of *T. absoluta* on sticky traps under glasshouse conditions.

Materials and Methods

The present study was carried out under glasshouse conditions during 2016-2017. The experiment was arranged in Randomized Complete Block Design (RCBD) with four replications. The following five treatments were used in different color sticky trap namely: blue, green, red, yellow and white were hanged in glasshouse at different phonological stages (vegetative, flowering and fruit setting). The traps were distributed between tomato plants at constant height (60cm above the ground). The captured *T. absoluta* moths were collected weekly and counted until the end of the crop harvest.

Data analysis

The effect of different colors and phonological stages of the plant were evaluated for caught of T. absoluta. The data was subjected to analysis of variance (ANOVA) and the means were compared by Least Significant Different (LSD) test at 0.05 levels, using SAS program version 9.1 [1].

Result and Discussion

Table 1: Cumulative Mean of *Tuta absoluta* caught in sticky traps with different colors during 2016 cropping season.

Treatments	Number of Adult Captured at Different Phonological Stages		
	At vegetative	At flowering	At fruit setting
Blue	1.85a	3.85a	5.08a
Green	0.63b	1.13c	1.63b
Red	0.35b	0.48c	1.00b
Yellow	0.83b	2.58b	2.70b
White	3.15a	4.33a	5.03a
LSD at 0.01	2.12	1.17	1.75
SE±	0.98	0.54	0.81

Table 2: Cumulative Mean of *Tuta absoluta* caught in sticky traps with different colours during 2017 cropping season..

Treatments	Number of adult captured at different phonological stages		
	At vegetative	At flowering	At fruit setting
Blue	2.50a	2.10b	2.50ab
Green	0.28c	0.58d	1.63bc
Red	0.00c	0.78cd	0.85c
Yellow	0.90c	1.80bc	1.55bc
White	2.28ab	3.45a	3.05a
LSD at 0.01	1.38	1.11	1.36
SE±	0.64	0.51	0.63

The results on (Table 1 & 2) showed that significant (P<0.01) differences were observed among the treatments. The results revealed that the different sticky color traps were captured Timato leaf miner during 2015 to 2017. The study was showed *T. absoluta* attraction has differential attraction to various colors in the sequence of white >blue >yellow >green >red during both study years 2016 and 2017. The maximum of moths (T. absoluta) were caught in white sticky color traps followed by blue sticky traps. The minimum number of moths of *T. absoluta* was caught in red and green sticky colored traps, respectively. The study of colored sticky trap on capturing of *T. absoluta* moths were showed effective control measures against the insect pest of T. absoluta. The mean number of caught in stick trap with different colors and phonological developmental stages of tomato plants. It was observed that the maximum number of *T. absoluta* caught in white sticky trap followed by blue colored at all developmental stages. In both years, maximum sticky trap catch of *T. absoluta* was significantly to higher in white traps (Table 1 & 2) and relatively more trap catch was observed during 2016 might be due to more incidence of *T. absoluta* moths. Similarly, captured percent of *T. absoluta* also showed on (Figure 1) during 2016 and on (Figure 2) during 2017. The highest captured percent was observed in white stick trap during first year 47%, 39% and 33%, at vegetative, flowering and fruit setting stages, respectively. Although the lowest captured percent was indicated on red sticky color. In 2016/17, the maximum captured percents of *T. absoluta* moths were recorded 32%, 39%, and 38% at vegetative, flowering and fruit setting stages, respectively. Similar to the first year the minimum captured percent recorded on red sticky colors.

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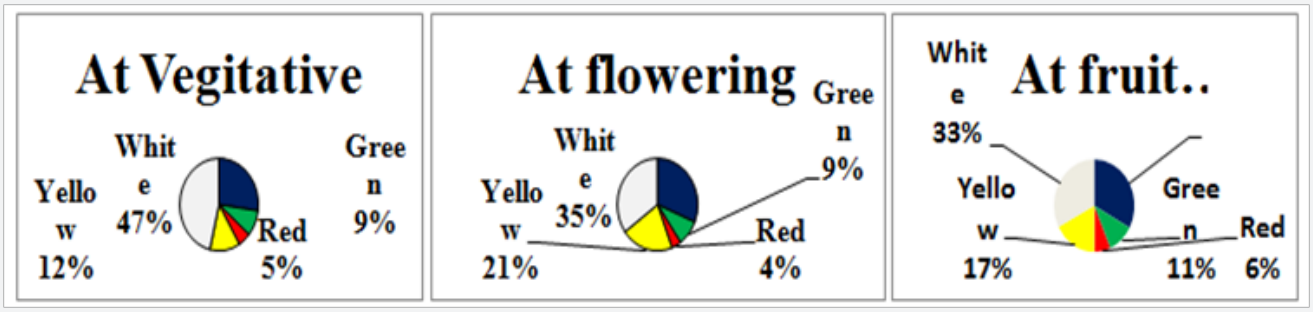

Figure 1: Effect of different color sticky traps for capturing of *T. absoluta* moths under Glasshouse during 2015/16

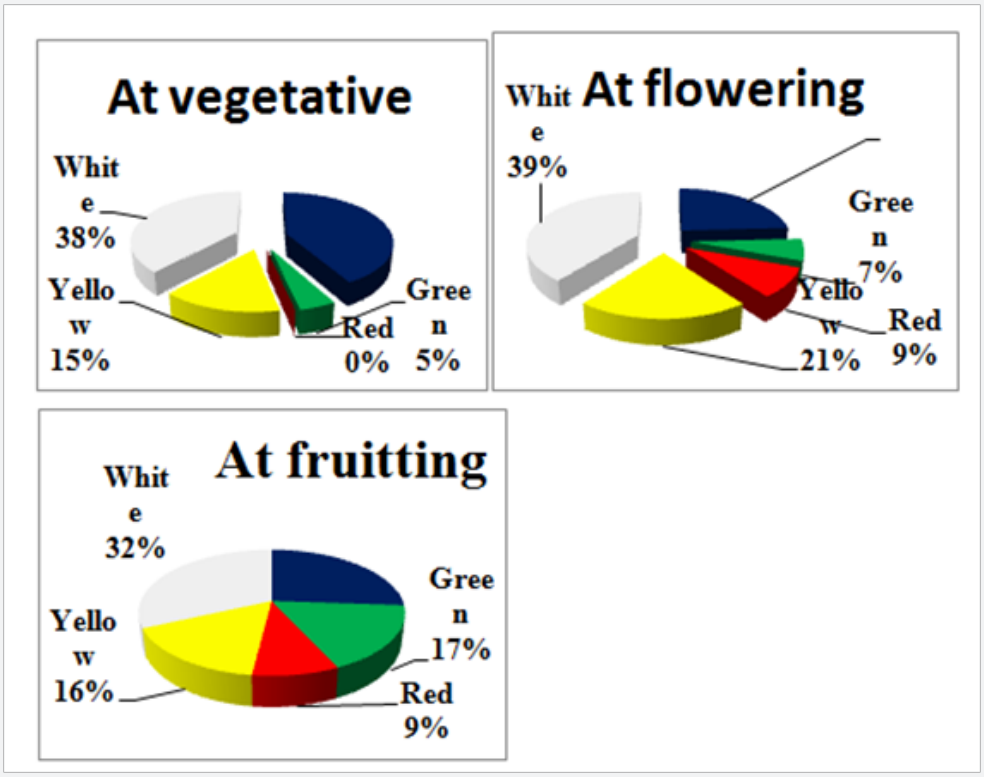

Figure 2: Effect of different color sticky traps for capturing of *T. absoluta* moths under Glasshouse during 2016/17.

It was recorded that the minimum numbers of *T. absoluta* moths were caught at vegetative stage in all colored sticky traps indicating to starting the infestation and appearance of *T. absoluta* moths while the maximum numbers were caught at fruit setting in both years. Also, white sticky trap caught higher number of moths than other traps during the whole tested phonological stages of the plant, white and blue sticky traps showed insignificant and yellow sticky traps came in the second order while the green and red are approximately equal in their efficiency for attraction *T. absoluta* moths and less efficient in comparison to white, blue and yellow sticky traps.

Our results inconsistence with white pheromone traps caught more moths than yellow, blue, green and red traps. Previous findings by various authors differed regarding attraction of various colors in attracting tomato leaf miner [12]. White and blue have been considered as the preferred or the most preferred colors for T. absoluta. White traps caught significantly more *T. absoluta* than the yellow ones in this study. Similarly, our results were assured the previous work of [13] where the means of weekly catches of both white and yellow traps are slightly different from one another while significant differences between means of sticky trap colors catches of white and blue traps from one point and other three traps from another point were recorded.

On the other hands, green and yellow traps caught more Grab Root Borer (GRB) moths than other traps (white and blue) and the males prefer green and yellow pheromone-baited traps [14], while red traps were most effective in trapping moths of *Helicoverpa armigra, Earis insulana* and *Plutella xylostella*, while yellow pheromone traps attracted maximum number of

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Spodoptera littoralis moths [15]. On the other insect pest study conducted by [16] on *Palpita unionalis* are closed with our results where they found that among the five colored sticky traps tested, white and yellow traps were most effective where white and yellow colors revealed. Although the previous study of Mahmoud et al. [13], they demonstrate the impotence of considering the visual stimuli of lepidopterous moths in the design of pheromone traps and further study is required however, to answer the question as to why *T. absoluta* moths are more attracted to white and yellow traps than to the other traps.

This study shows that plant phonological stages are strongly affect the response of *T. absoluta* moths to sticky traps colour. Therefore, the plant phonology is one of the most important aspects for capturing of T. absoluta.

Conclusion and Recommendation

This study showed that sticky trap color and tomato developmental stages were strongly affect the response of *T. absoluta* moths to color sticky trap. Colored sticky traps are a useful tool for monitoring their occurrence and abundance in glasshouse condition. The use of colored sticky traps at this period is an effective and easy to use method of early pest population control. It was found that, white and blue sticky traps can be more effective in capturing moths of *T. absoluta* population in glasshouses.

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