American Journal of BioScience
2022; 10(6): 191-194
http://www.sciencepublishinggroup.com/j/ajbio
doi: 10.11648/j.ajbio.20221006.12
ISSN: 2330-0159 (Print); ISSN: 2330-0167 (Online)

Comparison of Thrips (Thysanoptera: Thripidae) Attack Incidence on Five Onion (*Allium cepa* L., 1753) Varieties

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To cite this article:

Douan Bleu Gondo, Diarrassouba Nafan, Koffi Eric Blanchard Zadjehi, Coulibaly Tenon. Comparison of Thrips (Thysanoptera: Thripidae) Attack Incidence on Five Onion (*Allium cepa* L., 1753) Varieties. *American Journal of BioScience*. Vol. 10, No. 6, 2022, pp. 191-194.
doi: 10.11648/j.ajbio.20221006.12

Received: October 26, 2022; **Accepted**: November 11, 2022; **Published**: November 22, 2022

Abstract: Onion (*Allium cepa* L.) is a widely consumed food product in Ivory Coast. Unfortunately, low local production is noted, forcing the State to remain dependent on the countries of the sub-region and Europe. A significant increase in local onion production is, therefore, necessary. This necessarily involves sustainable management of the entomological constraints of onion cultivation which remains little known in Ivory Coast to date. This study aims at evaluating thrips (Thysanoptera: Thripidae) incidences, the main insects harmful to onion cultivation in the northern Ivory Coast. These incidences were evaluated on five (5) onion varieties (SAFARI, BATI, CARA, VIOLET DE GALMI, and ROUGE KARIBOU) on a weekly basis from four (4) weeks after transplanting until bulbs maturity. A factorial ANOVA was used to test the variety and sampling period effects. It showed that the incidence of thrips is low at the start of cultivation, and increases significantly with vegetative growth. The incidences of thrips vary between onion varieties. SAFARI was the most attacked variety by thrips with incidences that can exceed 40%. SAFARI was followed by BATI, CARA, and VIOLET DE GALMI which presented intermediate incidence. ROUGE KARIBOU variety recorded incidences of less than 20% throughout the crop cycle. This variety (ROUGE KARIBOU) could be recommended to market gardeners because it is less attractive to thrips.

Keywords: Incidence, Insects, Onion, Thrips, Ivory Coast

1. Introduction

Onion Thrips (Thysanoptera: Thripidae) transmit plant-infecting viruses such as Iris yellow spot virus (IYSV, of the genus Tospovirus), an economically relevant viral threat to onions in many parts of the world. The losses may reach up to 100% [1-3]. Thrips are more and more difficult to control because they have developed resistance to insecticides [4]. They constitute the major entomological constraint of onion cultivation in the world. However, onions have a strong nutritional potential for consumers, the bulbs are rich in calcium, magnesium, iron, zinc, and manganese [5]. According to the Interprofessional Fund for Agricultural Research and Advice (FIRCA) (2020), the national production has so far remained very low (consumption average of less than 1 kg/year/inhabitant in the 1960s to more than 3 kg/year/inhabitant at the beginning of the 2010s) [6]. Indeed, due to ever-increasing demands, ivorian imports between 90% and 95% of its needs. Very little work has been undertaken in Ivory Coast on onion. This work concerns the selection of onion varieties (*Allium cepa* L.) adapted in the northern part of the country [7]. This work evaluated the agronomic performance of sixteen introduced varieties in comparison with a local variety. Studies on the susceptibility of onion varieties to thrips attacks in agroecological zones close to the present study have been undertaken in Burkina Faso. Indeed, Garane *et al.* (2018) [8] evaluated the field behavior of some onion (*Allium cepa* L.) and shallot (*Allium cepa* var. asculoni cum) varieties for the winter crop in central Burkina Faso. It emerged from their work that the variety VIOLET DE GALMI is sensitive to thrips attacks. Despite the importance of studies on the evaluation of the onion varieties' sensitivity to thrips attacks, it is clear that very few studies have been carried out in Ivory Coast in this regard. This study was undertaken to fill this gap in scientific

information on the sensitivity of onion varieties to thrips attacks. The objective was to contribute to the improvement of onion productivity in the northern Ivory Coast through sustainable management of thrips, the main insect pests of this crop. Thus, the impact of thrips attacks was evaluated in the field on five (5) onion varieties including SAFARI, BATI, CARA, VIOLET DE GALMI, and ROUGE KARIBOU. The variety (ies) less susceptible to thrips attack as a result of this study could be advised to farmers to help them better manage onion thrips in the North as well as other regions of Ivory Coast.

2. Material and Methods

2.1. Experimental Set-Up and Evaluation of the Incidence of Thrips Attacks

This study was undertaken at the botanical garden of the Peleforo GON COULIBALY University of Korhogo in northern Ivory Coast. No onion crops were grown recently on or near the plot. The experimental design consisted of two completely randomized Fisher blocks named Block A and Block B. Each block included two replicates of each of the five onion varieties (SAFARI, BATI, CARA, VIOLET DE GALMI, and ROUGE KARIBOU). Each replication was made up of a plot 1.5 m wide and 4 m long, i.e. an area of 6 m^2. Each elementary plot consisted of seven (7) onion lines spaced fifteen (15) cm apart with ten (10) cm separating the onion plants in one line. The density was one hundred and five (105) plants per elementary plot. The onion plants after transplanting were observed weekly using a biconvex magnifying glass at magnification 4 (Manutan A012946). Three non-contiguous lines were marked, leaving one line at each edge of the elementary plot. Fourteen (14) plants were selected and observed per line, i.e. 42 plants per elementary plot. One (1) month after transplanting, the first signs of thrips attack were observed. The visits were made from the fourth to the tenth week after transplanting. The incidence of thrips attacks was calculated according to the following formula:

$$Incidence\ (\%) = \frac{Number\ of\ attacked\ plants\ (NAP)}{Total\ number\ of\ sampled\ plants\ (TSP)} \times 100$$

2.2. Data Analysis

The average incidences according to varieties and time after transplanting as well as the standard deviations were calculated using the Excel 2016 software. The first analysis of variance with one factor (Variety) allowed the differences in the average incidence of thrips attacks between the different varieties to be highlighted. The second one-factor analysis of variance (Time after transplanting in weeks) allowed the differences in the average incidence of thrips attacks according to the time after transplanting to be highlighted for a given onion variety. Once the differences in means were noted, the post hoc Student-Newmann-Keuls multiple comparison test with 5% threshold was used to classify the mean incidences into homogeneous groups. These statistical analyses were performed using IBM SPSS version 20 software.

3. Results

3.1. Comparison of the Incidence of Thrips Attacks According to Onion Varieties

Table number one (1) shows the average incidences of thrips attacks followed by standard deviations. In each column of the table, these incidences were compared between varieties for a given number of weeks after transplanting. The results of this study showed that the incidence of thrips attack was not statistically different at four (4) weeks (F = 1.981; p = 0.236) and five (5) weeks (F = 0.848; p = 0.543) after transplanting for the five (5) onion varieties (Table 1). Six (6) weeks after transplanting, the incidences of thrips attack on SAFARI were higher than those of the four varieties BATI, CARA, VIOLET DE GALMI, and ROUGE KARIBOU (F = 7.155; p = 0.013). From week 7 to week 10, thrips attack incidences were classified into three homogeneous groups with the first group consisting of ROUGE KARIBOU variety with the lowest thrips attack incidence, the second consisting of BATI, CARA, VIOLET DE GALMI varieties with intermediate thrips attack incidences and the third consisting of SAFARI variety which recorded the highest thrips attack incidence (Table 1).

Table 1. *Average attack incidence of thrips on five onion varieties according to the number of week after transplanting.*

Onion variety	AVERAGE ATTACK INCIDENCE ± S D (%)								
	Number of week after transplantation								
	4th week	5th week	6th week	7th week	8th week	9th week	10th week	F	p
Bati	12.5 ± 3 a A	18.67 ± 4 b A	26.67 ± 1 b A	35 ± 5 c AB	27.5 ± 2 b AB	29.17 ± 10 b AB	20.83 ± 7 b AB	8.55	0.004
Rouge Karibou	12.5 ± 3 a A	14 ± 4 a A	18.5 ± 5 a A	15.83 ± 8 a A	11.67 ± 5 a A	10 ± 2 a A	7.5 ± 2 a A	1.501	0.290
CARA	10 ± 2 a A	15.5 ± 4 b A	23.33 ± 8 b A	29.17 ± 1 b AB	28.33 ± 5 b AB	27.5 ± 2 b AB	20.83 ± 6 b AB	6.536	0.009
Violet De Galmi	12.5 ± 6 a A	13.67 ± 3 a A	34.33 ± 13 b A	30.83 ± 10 b AB	27.5 ± 6 b AB	26.67 ± 3 b AB	22.67 ± 2 b AB	3.813	0.04
SAFARI	16 ± 5 a A	17.5 ± 4 a A	41.33 ± 4 b B	40 ± 4 b B	38.33 ± 3 b B	43.33 ± 2 b B	32.5 ± 11 b B	8.159	0.005
F	1.981	0.848	7.155	7.250	9.274	13.000	4.751		
p	0.236	0.543	0.013	0.026	0.016	0.007	0.049		

In each row, the average attack incidences followed by the same letter (in lower case) are not statistically different according to the Student-Newman-Keuls test at the 5% threshold

In each column, the average attack incidences followed by the same letter (capital letter) are not statistically different according to the Student-Newman-Keuls test at the 5% threshold; F: Statistic; p: critical probability; SD: Standard Deviation

3.2. Comparison of the Incidence of Thrips Attacks According to the Number of Weeks After Transplanting

In each row of the table, the incidence of thrips attack was compared according to the number of weeks after transplanting for a given onion variety. These results showed that in the BATI variety, the incidence of thrips attack changed significantly with time ($F = 8.55$; $p = 0.004$). They were classified into three homogeneous groups consisting of the 4th week; the 5th, 6th, 8th, 9th, and 10th weeks and the 7th week (highest incidence of thrips attack (35± 5%) (Table 1).

The ROUGE KARIBOU variety recorded low incidences of thrips attacks which did not change statistically throughout the crop cycle ($F = 1.501$; $p = 0.290$) (Table 1).

CARA recorded incidences that changed significantly over time ($F = 6.536$; $p = 0.009$). These incidences were classified into two homogeneous groups, the first of which consisted of the 4th week, and the second of the 5th, 6th, 8th, 9th, and 10th weeks after transplanting (Table 1).

The varieties VIOLET DE GALMI and SAFARI recorded incidences that changed significantly with time (VIOLET DE GALMI ($F = 3.813$; $p = 0.04$); SAFARI ($F = 8.159$; $p = 0.005$). These incidences were classified into two homogeneous groups, the first of which consisted of the 4th and 5th week, and the second group formed by the 6th, 7th, 8th, 9th, and 10th week after transplanting (Table 1).

4. Discussion

The aim of this study was to evaluate the incidence of thrips attacks on five onion varieties. It could contribute to improving onion productivity in Ivory Coast. This study is of paramount importance for good onion productivity in Ivory Coast because onion thrips, insects belonging to the order Thysanoptera and the family Thripidae, are harmful to the crop not only by consuming plant tissues but also by transmitting viruses to the onion plants when they take food. The most damaging of these viruses is the Iris yellow spot virus (IYSV, of the genus Tospovirus), which is an economically relevant virus threat to onions in many parts of the world. Losses can reach up to 100% [1, 2, 9, 3]. In addition, thrips are increasingly difficult to control as they have developed resistance to insecticides [4]. Other authors such as Leach *et al.* (2020) [10] noted a reduction in onion bulb size by 28-73% and a reduction in the photosynthetic capacity of attacked plants due to thrips attacks. One of the significances of this study is that thrips reproduce by parthenogenesis, which makes them very prolific and difficult to control [10].

Five varieties were studied. These are BATI, CARA, VIOLET DE GALMI, SAFARI, and ROUGE KARIBOU. The study showed that not all onion varieties are equally attractive to thrips. Indeed, the SAFARI variety recorded higher incidences of thrips than the other varieties. As for the ROUGE KARIBOU variety, it showed the lowest attractiveness to thrips. The other three varieties BATI, CARA, and VIOLET DE GALMI recorded intermediate incidences. These results corroborate those of Diaz-Montano *et al,* (2010) [11] and Leach *et al,* (2020) [10] who showed the existence of Thrips susceptible and resistant varieties. The variety VIOLET DE GALMI is said to be susceptible to thrips attacks according to studies conducted in Burkina Faso by Garane *et al.* (2018) [8]. Diaz-Montano *et al.* (2010) [11] also showed that onion varieties with blue-green foliage were more attractive than those with yellow-green foliage, which were less attractive.

An increase in the incidence of thrips attacks with the vegetative growth of the plants was noticed. Only the ROUGE KARIBOU variety seemed to attract a statistically constant and weak number of thrips, compared to the other four varieties during the whole crop cycle. This attractiveness reached a peak around the 7th week after transplanting before decreasing. This could be explained by an increase in the concentration of phytohormones produced by plants due to vegetative growth. The decrease in biomass as the bulbs approach maturity would also be the cause of the decrease in attractiveness with time from the 7th week. The incidences obtained in the case of this study are lower than those found by Savadogo *et al*. (2020) [12] in a study in Burkina Faso. In fact, the latter reported incidences of thrips attacks higher than ninety percent. This high incidence of thrips attacks could be explained by the fact that their study was conducted in a farming environment where several onion crop cycles had followed one another, allowing for thrips outbreaks, unlike our study site, which did not have an onion crop precedent. This study yielded interesting results because it showed that not all onion varieties are equally attractive to thrips. Their association on the same plot could contribute to the control of these insect pests. Indeed, previous studies have shown that combining or mixing varieties of the same crop species allows diversification of a crop and thus reduces the damage and expansion of diseases and pests on it. This practice would be very interesting for increasing the durability of varietal resistance and thwarting pest attacks [13]. Other authors recommend the use of biopesticides such as azadirachtin and spinosad for onion thrips management [14-16].

5. Conclusion

The present study, which is a first in the zone, allowed the recognition of thrips attacks and the calculation of the incidence of thrips attacks, and insects pest of the onion crop. The aim was to assess the attractiveness of five onion varieties to thrips. The study showed that the ROUGE KARIBOU variety is the least attractive, while the SAFARI variety is the most attractive. This study provides a basis for evaluating the performance of any new onion variety being introduced in the northern Ivory Coast. It deserves to be pursued along such lines as the identification of thrips species harmful to onion crops in the northern Ivory Coast,

the identification of the various natural enemies of thrips species harmful to onion crops, and the cultural associations likely to significantly reduce thrips attacks.

Acknowledgements

This study was made possible thanks to the university authorities of the Peleforo GON COULIBALY University of Korhogo who provided the necessary space and to funding from the Korea-Africa Food and Agriculture Cooperation Initiative (KAFACI). May they find here the infinite gratitude of the authors.

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