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Influence of Abamectin Treatment Against Parlatoria Blanchardii, on Entomological Diversity in the Palm Groves of Ouargla (Algerian Sahara)

RAÂCHE Arwa[1,2] and SEKOUR Makhlouf[1,3]

[1]Departement of Agronomic Sciences, University of Kasdi Merbah, Ouargla, Algeria.
[2]Research Laboratory on Phoeniciculture (Phoenix) University of Kasdi Merbah, Ouargla, Algeria.
[3]Laboratory of Saharan Bioresources: Préservation and Valorization, University of Kasdi Merbah, Ouargla, Algeria.

[1]Corresponding Author E-mail: arwaraache30@gmail.com
[2]E-mail: babahani.souad@gmail.com

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Abstract. Landscaping and agricultural practices are very essential to limit the damage of depredators, but unfortunately the latter affects the entomological diversity, especially when using chemicals products. The objective of our study is to determine the effect of abamectin on the balance of the entomological fauna, in three palm groves cultivated with two cultivars (Deghlet Nour and Ghars), during a control against Parlatoria blanchardi, using the date palm leaves threshing method. Indeed, the application of abamectin leads to significant difference in mortality rates (p-value 2.753*10-10), between the study stations, and between the two varieties. The inventory of enthomofauna before product use results in a total of 124 species in both varieties. However, we recorded the lowest number of species at the second station (Deghlet Nour: S=14 sp) and (Ghars: S= 16 sp). The use of the abamectin affects at first beneficial species (S= 10 sp), followed by indifferent species (S= 12 sp) during treatment time. The highest total richness is recorded in the pest group (S= 14 sp), followed by the groups of indifferent species (S=4 sp), then the useful species have disappeared after 72 hours of treatment. The results obtained clearly show that the insecticides used in palm groves constitute a real threat to fauna in general, and for useful species and auxiliaries of Parlatoria blanchardi in particular.

Keywords. Abamectin, Inventory, Enthomofauna, Parlatoria blanchardi, Date palm.

1. Introduction

Date palm cultivation in Algeria has about 18 million trees cultivated on an area of 169,380 ha producing 500,000 tons of dates per year [1]. It contributes in a very important way to the food security of the Saharan populations, of which 4 to 5 feet of date palm can ensure the food self-sufficiency of one family [2]. In addition, several phytosanitary constraints can hinder the development of this crop, in particular diseases and pests, such as *Parlatoria blanchardi*, *Ectomyelois ceratoniae* and *Oligonychus afrasiaticus*, which are very feared pests, especially on date palms [3]. Despite the new phytosanitary crop protection techniques based on the concept of integrated pest management and the use of the tolerance threshold therefore the selectivity [4], in Algeria, the fight against these pests continues to rely on phytosanitary products based on synthetic pesticides.

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Abamectin is one of the effective, labelled and widely used pesticides as an insecticide/acaricide for more than 30 years due to its higher bioactivity against insect and mite pests [5,6]. The latter acts by ingestion and prevents the transmission of nerve impulses by causing rapid paralysis of the insect, then its death [7]. Its use against predators has been well documented by many researchers [8-10].

The abusive and unreasonable use of chemicals [11] and farmers' ignorance of their danger aggravates their harmful effects and generates most often irreversible consequences [12,13]. Indeed, negatively affecting biodiversity [14], and causing the scarcity and destruction of useful fauna. Unfortunately, many insects and mites have developed high resistance to this pesticide [15].

2. Material and Methods

2.1. Zone of Study

The Ouargla basin (29° 13' to 33° 42' N., 3° 06' to 5° 20' E.) is located 800 km south-east of the capital Algiers at an altitude of 164 m above the sea level. It is an oasis known by an agricultural activity strongly dominated by the date palm (Phoenix dactylifera L.). It is characterized by a dry period which extends throughout the year and is located in the Saharan bioclimatic stage with mild winters.

In this region, three palm grove are selected for this study. Two of them (Mekhadema, Hassi Ben Abdellah) use drip irrigation system, while the third station (Chott) use submersion irrigation system.

2.2. Presentation of Study Sites

The study was carried out at the level of three palm groves in the Ouargla region, which each palm grove covers an area of 1 ha and characterized by the dominance of two varieties Ghars and Deghlet-Nour.

Palm grove 1(Hassi Ben Abdellah): located northeast of the region (32°00’76.62’’N, 5’45’69.43’’E), it’s a new exploitation with organized and regular planting. The number of date palms is 140 trees. The spacing between the palm trees varies between 8 to 10 m. We also note the presence of some fruit trees such as *Ficus carica* and *Citrus limon*. Other associated cultures must be reported, including Mentha aquatica and Medicago sativa. As for spontaneous plants, we quote: *Cynodon dactylon*, *Polypogon monspeliensis*, *Anagalys arvensis*, *Sonchus maritimus* and *Sonchus oleraceus*. It should be mentioned that the palm grove is delimited by other neighbouring palm groves. In addition, it undergoes chemical treatments annually with phytosanitary products.

Palm grove 2 (Mkhadma): (31°56'34.62" N, 5°18'06.85") is positioned on the south-west side of the city of Ouargla, 6km from the city center, at an altitude of 136 m. It is a farm with regular and organized plantation, arranged and well exploited. Divided into two parts, one part for cattle and camel breeding and the other part for the cultivation of the date palm which contain 100 trees between Ghars and Deglet-Nour which is the most dominant. The distance between the trees varies between 7 to 9 m. A few associated cultures are present, such as Brassica oleracea, Medicago sativa, as well as spontaneous plants such as *Cynodon dactylon*, *Phgragmites communis*, *Lavatera cretica*, *Polypogon monspeliensis*, *Suaeda fructicosa* and *Frankenia pulverulenta*. The palm grove is moderately maintained and phytosanitary treatments are practiced.

Palm grove 3 (Chott): The palm grove (31°57'28.82"N, 5°21'31.38"E) is located on the north side of the city center of Ouargla. It is an old plantation organized and well maintained. The total number of date palms is 70 trees. In addition, some fruit trees are cultivated such as *Punica granatum*, *Vitis vinifera*. Under the palm trees *Brassica oleracea* and *Lactuca sativa* are cultivated. The spontaneous plants observed on both sides at the level of the station are *Sonchus oleraceus*, *Chenopodium mural*, *Cynodon dactylon*, with the presence of a non-functional drainage system.

2.3. Methodological Approach

In order to highlight the effects of Abamectin on date palm arthropods, the study involved the following two steps:

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- Application of Abamectin against white cochineal on a few date palms,
- Evaluation of the rate of arthropods and particularly that of auxiliaries because of their importance for the palm tree.

The methodological approach consists in estimating the number of arthropods affected by the insecticide abamectin, within the framework of a chemical fight against the white cochineal, and evaluating their effect on all the entomofauna (pests, beneficial and auxiliary species). We chose a plot of one hectare containing plants of the Deghlet Nour and Ghars variety where the palm trees have a medium to heavy infestation by the white cochineal. At the level of the three palm groves in the Ouargla region, spraying the palms with Abamectin (15l per palm tree) using a sprayer, using the approved commercial dose (Agricultural Productivity Program in East Africa West) and recommended at 18 g/l.

To estimate the mortality rate of the affected insects, we conducted a threshing of the leaves at the rate of three strokes per sheet (one leaf for each cardinal direction). Four trees are randomly selected for each variety. We then proceeded to the threshing before and after processing and collecting the fallen arthropods. Palms that had not undergone treatment served as controls. The arthropods collected are placed in petri dishes in order to undergo counting and identification.

For the exploitation of the results, different indices are used, in particular the total wealth (S) and average (Sm). The Kruskal-Wallis test is used for the statistical analysis.

3. Results and Discussion

3.1. White Cochineal Infestation Rate During Treatment

The results obtained concerning the rate of infestation of the white cochineal during treatment with Abamectin, show a highly significant deference (P-value 2.753*10-10) over time for each variety (Fig.1). According to [16,17], the Deghlet Nour cultivar is more infested by the white cochineal than Ghars. It was found that despite the application of treatment with abamectin, the infestation in the three palm groves by *Parlatoria blanchardi* is very important.

The faunal sampling carried out following the use of the threshing method on the two varieties Ghars and Deghlet Nour, enabled us to identify a total of 124 species of arthropods on the three study stations (Tab. 1). We note the difference in the total richness (S) during the treatment, of which the Ghars variety records (S=30, Sm =2.33± 1.81) in station 1, while Deghlet Nour notes a low average (Sm=2.46±3.09).

After 72 hours of the application of abamectin, a decrease in the number of individuals as well as the richness in the two varieties was marked at the three studies stations, of which station 2 is the most affected by the insecticide.

Table 1. Number of individuals (Ni), total (S) and average (Sm) richness of arthropod families recorded by the beating method in the study stations before, during and after treatment with abamectin.

		Befor			During			After		
Stations	**Variety**	**S**	**Sm**	**SD**	**S**	**Sm**	**SD**	**S**	**Sm**	**SD**
Station 1	Deglet Nour	26	1,8	1,1	22	3,2	2,09	14	1,36	0,63
	Ghars	34	3,3	2,7	30	2,33	1,81	18	2	1,37
Station 2	Deglet Nour	14	3,31	0,39	11	2,47	1,46	7	1,14	0,38
	Ghars	16	4,5	2,27	15	3,64	2,22	8	1,5	0,53
Station 3	Deglet Nour	29	2,07	1,14	25	4,76	1,9	13	1,63	1,06
	Ghars	32	1,3	0,7	29	2,14	1,7	8	2,54	2,26
Total		121			52			40		

S: total wealth Sm: average wealth SD: deviation

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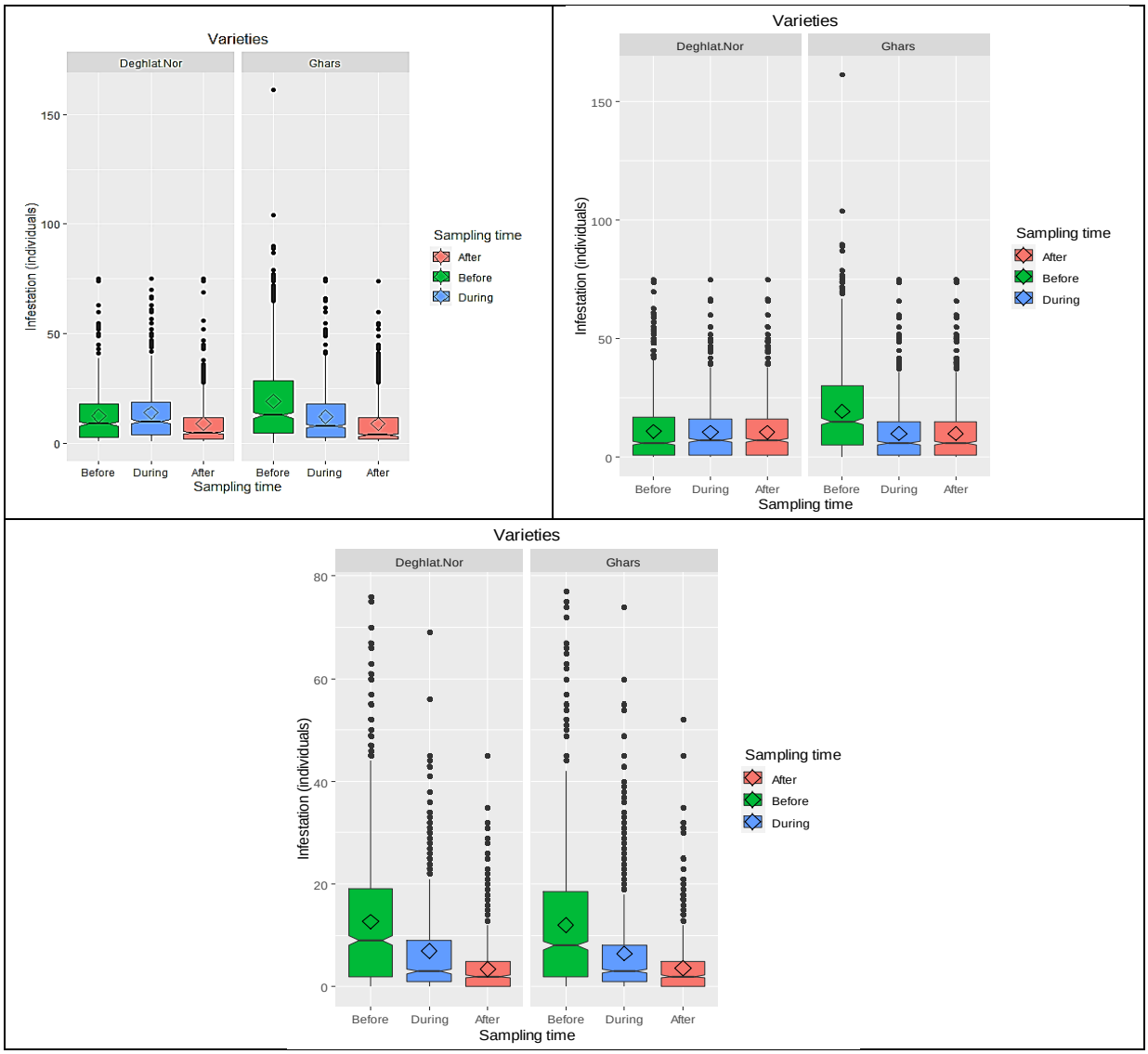

Figure 1. Infestation rate of the white cochineal on the two varieties Ghars and Deghlet Nour during the application of abamectin in the three stations Mekhadema, Hassi Ben Abdallah and Chott.

3.2. Influence of Abamectin on Fauna

The collection of the date palm entomofauna before the application of abamectin shows that there is a very significant infestation of pests, especially the diaspidae. On the other hand, the number of indifferent species and useful species is low compared to the degree of date palm infestation (Fig.2). It is mentioned that there is no significant difference between the three groups (p=0.0659) in the number of individuals.

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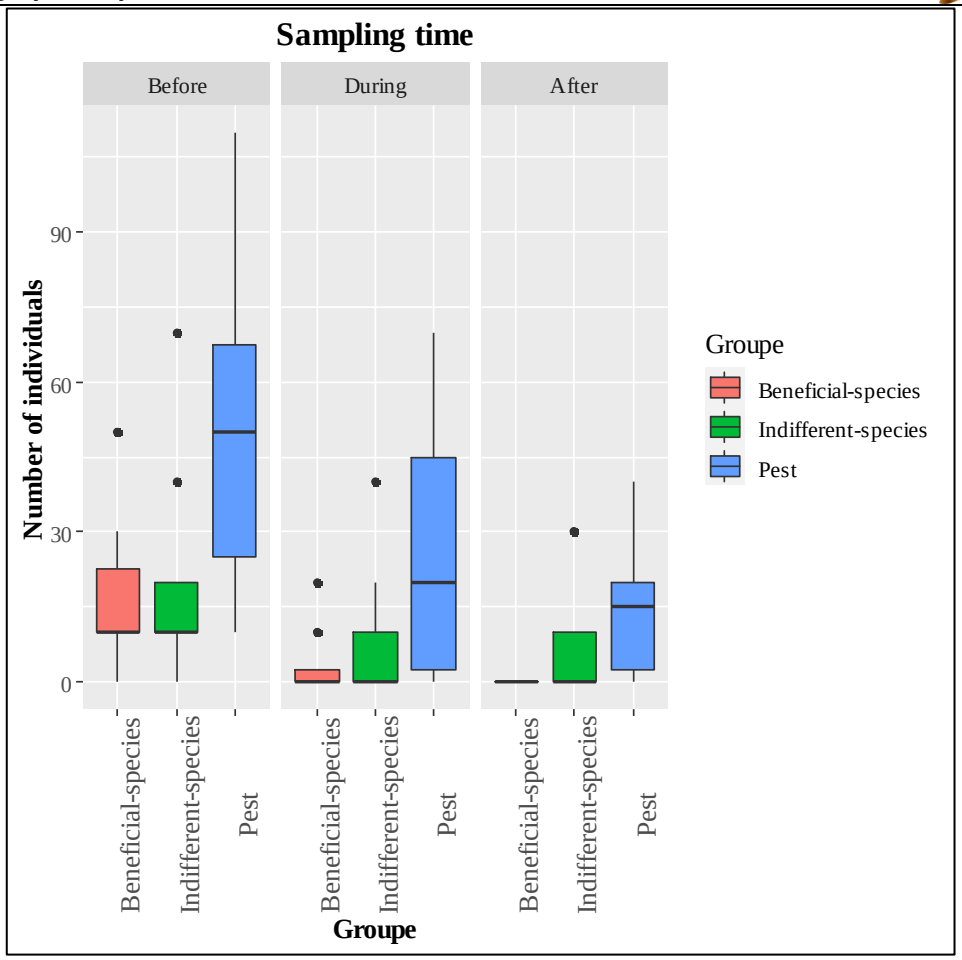

Figure 2. Number of different arthropod groups before, during and after application of abamectin.

After 24 hours of spraying the insecticide, the treatment did not make a considerable difference on the numbers of the three groups ($p = 0.1077$), however, the useful species are the most affected compared to the two groups.

After 72 hours of treatment, a highly significant difference ($p = 0.008$) was recorded between the groups, especially useful species and pests ($p= 0.0075$). Firstly, we had recorded a total disappearance of auxiliaries, and the drop in the number of indifferent species, followed by the population of pests so the Abamectin affects mainly useful species.

3.3. Influence of Abamectin on Entomological Groups Before, During and After Treatment

According to the Kruskal-Wallis test, it is noticed that the treatment with abamectin on pests did not make a significant difference ($p = 0.139$) on the number of individuals for pests during treatment (Fig.3). On the other hand, the last group has a very highly significant difference recorded ($p= 9.251e-05$) where an immediate effect (disappearance of useful species) is noticed. Regarding the number of indifferent species, there was no significant difference ($p = 0.1283$) over the treatment period.

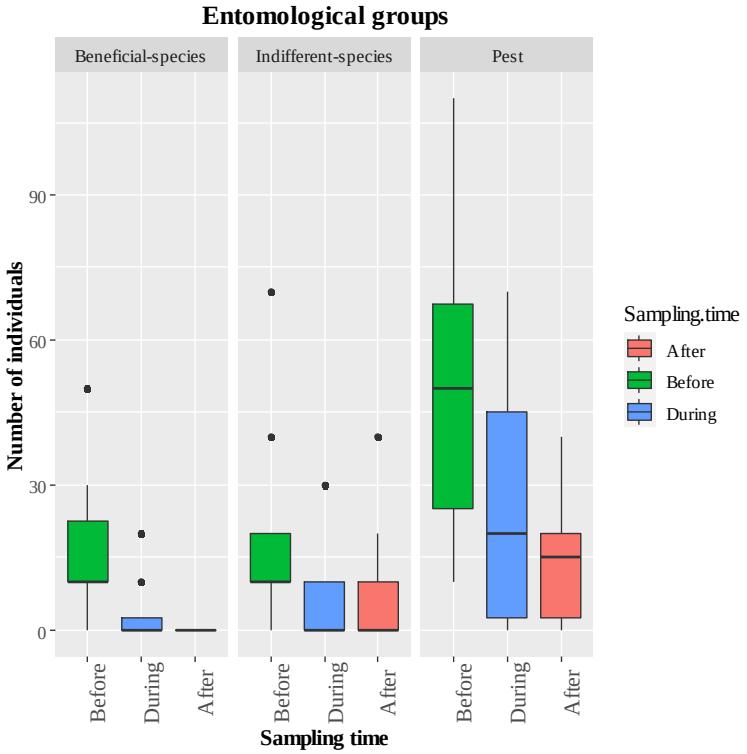

Figure 3. Number of different groups of arthropods before, during and after the application of abamectin.

TABLE 2. Group of arthropods identified by the beating method classified by family.

Pests	Indifferent species	Useful species
Diaspidae	Formicidae	Coccinilidae
Tytranichidae	Culicidae	Chrysopidae
Bruchidae	Salticidae	Pyntatomidae
	Aranea	Lygaeidae
		Syrphidae

4. Discussion

The chemical control against *Parlatoria blanchardi* using Abamectin isecticide causes an imbalance in the entomological fauna in the palm groves of the Ouargla region. Abamectin is one of the insecticides/acaricides which is toxic, but the significant infestation of the white cochineal and the poor maintenance of palm groves interrupt the effectiveness and impact of this treatment.

It should be noted that the three palm groves are heavily infested by the white cochineal, particularly the Deghlet Nour variety, these results confirm several authors such as [16,18,19], and [20] who worked on the relationship between the white cochineal and some varieties of dates in the same region, finds that the most infested varieties are: Hamraya, Deglet-Nour and Ghars with successive densities of 19.68, 15.50 and 15.13 coch/cm². [21] declares the same thing at the level of a palm grove in the Biskra region. Cochineal preference for a particular variety may be explained by the biochemical composition of date varieties [20].

Regarding the diversity of arthropods at the level of the three palm groves before treatment, an average richness (Sm = 6 ± 1.04) was recorded high at the level of the Ghars variety in the three palm groves, on the other hand [22] report the highest average insect richness (Sm = 12.50 ± 1.04) on the Deghlet Nour variety in the same region, due to the relationship with the population level of their prey and possibly the climatic conditions [23]. The low effectiveness of abamectin on pests, particularly

Parlatoria blanchardi, can be explained by the importance of the latter as well as the climatic conditions in the month of Mai (high temperature and high intensity light of the sun) which auxiliary the evaporation and product degradation.

The application of abamectin causes a drop in the number of species associated with white cochineal during and after treatment (Sm = 1.14 ± 0.38) especially in the second station (Hassi Ben Abdallah).

The use of an acridicide in the region of Ouargla, indiscriminately decimated the useful and harmful entomofauna of the date palm, of which 69.7% of the identified species are killed [12]. Studies have shown that abamectin is harmful to the auxiliaries of the white cochineal such as ladybugs, [24] revealed that abamectin is toxic on the larval stages as well as the adults of the predatory ladybug (*Harmonia axyridis*) following its use in greenhouses at the recommended dose (18.4 g/l). In Niger states that after pesticide applications (Chlorpyrifos-ethyl and Fenitrothion), the relative abundance of Formicidae dropped sharply within a day (shock effect) [25].

Indeed, Fourmicidae are important in ecosystems and are predators of many pests [26], for its part, [27] also showed that the three species *P.ovoideus*, *P. numidicus* and *C. seminillum* were strongly affected by a treatment against *Parlatoria blanchardi* based on Folimat or Omethoate at 50% in a palm grove in the region of Ouargla (Algeria), this treatment caused mortality rates varying from 76.02 to 83.89%. In addition, chemical treatments in palm groves in Palestine practically all Coccinellidae were killed. This is the same result that we found after 72 hours of application of abamectin [28].

Another study on the effect of some insecticides on natural enemies, finds that the treatments made on ornamental plants are very toxic on the parasitoids *Encarsia spp* and *O. insidiosu*s [29]. Their harmfulness found on other works [30,31,32]. Finally, insecticides always affect entomofauna, especially natural enemies, by a lethal effect or by sublethal effects, affecting some of their biological parameters, such as larval development, reproduction and predation) [33,34,35].

Conclusion

This study allowed us to make an initial observation on the influence of abamectin on entomological diversity in the palm groves of the Ouargla region, as part of the chemical control against *Parlatoria blanchardi*. Indeed, the Deghlet Nour variety was the most infested with white cochineal than the Ghars variety.

Treatment with abamectin results in an imbalance on entomofaune, especially as it negatively affects beneficial arthropods.

Ultimately, this pesticide poses a threat to diversity in general, and to useful species and auxiliaries in particular. The use of pesticides must take into account the sensitivity of the useful fauna to phytosanitary treatments.

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