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# CONTENTS

## ORIGINAL PAPERS

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# INSECTICIDAL IMPACT OF AQUEOUS PLANT EXTRACTS (CAROB, OLEANDER, ALEPPO PINE AND BITTER ORANGE) AND BASALT FLOUR "FARINA DI BASALTO® XF AND XM" AS A BIOLOGICAL SOLUTION TO CONTROL CEREAL PESTS

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## ABSTRACT

Integrated pest management of cereal crops uses all necessary methods to reduce pest populations. These methods: such as plants' aqueous extracts, are usually efficient, economical, and respectful towards the environment. These products are used to control pests and evaluate their effect on cereal plants. The experiment was conducted in a barley field. The bioinsecticides tested were the aqueous extracts of four vegetal plants (Carob, oleander, Aleppo pine, and bitter orange) and basalt flour "Farina di Basalto® Type XF and Type XM" as mineral material. The tested doses were in order of 5% and 1,5% for plants and basalt aqueous extracts respectively. They were tested against aphids, thrips, and cereal leaf beetles. The experimental design was a complete random block (CRB). Every treatment had 3 replicates, and their distribution was random. The morphometric parameters (roots weight and length, stem length and leaf area), efficiency and mortality rates were calculated to evaluate the effect of the different products on cereal plants and pests. The tested aqueous extracts were not toxic towards plants. Thus, the morphometric parameters showed that the plant development was normal during the management such as the control. All aqueous extracts were efficient in pest management by reducing their populations. For basaltic extracts, foliar (XF - "Farina di Basalto® Type XF") was lethal for thrips and cereal leaf beetles by around 70% and combined (XM - "Farina di Basalto® Type XM" and XF "Farina di Basalto® Type XF") for thrips and aphids by 75.20 and 34.66% respectively. For botanical extract, carob (Cs) was toxic against thrips and aphid by 73.39 and 44.21% respectively and oleander (NeO) was relevant against thrips and cereal leaf beetles by 76.94 and 36.67% respectively. For cereal leaf beetles, the aqueous extracts helped to mitigate their leaves' damage. Using plants and mineral powder is not only an effective method for pest management but also a friendly alternative, especially since it has lower toxicity against cereal plants.

**KEYWORDS:**
Aromatic plants, cereal pests, basalt flour, aqueous extracts

## INTRODUCTION

Using chemical insecticides is a common method to control pests in crop production areas over the world in the purpose to reduce yield losses and preserve quality of product. According to several researches, chemical product usually proved impractical, ineffective, highly influenced by weather conditions. Furthermore, they affect negatively human health and environment [1–4]. In agriculture, these pesticides are toxic to natural enemies which are useful against pests [1,2,4]. Thus, biological control in its different alternatives seems to be a successful method to control pests and pathogens. Among these alternatives, many of them are empirical methods and conventionally used to control pests as biopesticides which are plants extracts as essential oils or aqueous extracts [5–9]. These plants tissues contain lethal bioactive components (secondary metabolites) for insects, mites and other organisms These components are beneficial as natural defensive process for plants also they are progressively adopted in pest management [5,7,8,10–13]. Researchers approved that bioinsecticides are less harmful to environment or to human health the way they are more selective, more rapidly degradable comparatively to chemical insecticides [14–18].

Diverse plants extracts have been tested to control various insect pests [18–21]. As botanical sources, different parts of *Citrus* species were used in several research against Diptera, Lepidoptera and Coleoptera pests [22–28]. Other than botanical bioinsecticides, organic and mineral dust and rock were used in pest management. Inert dusts such as road dust and powdered clay has well known by humans. Animals as mammals and birds used dust baths as a protection against ectoparasites [29]. Furthermore, Kaolin is approved as a successful alternative for pest management in safe environmental. Glenn and Puterka [30] define Kaolin as a white aluminium-silicate mineral which is non-porous, chemically inert, non-swelling, low-abrasive, and fine grained that easily disperses in water. As well, the basalt powder is silicate rock that one of the most common chemical compounds is the silicon dioxide [31,32]. The basalt powder used as fertilizer leads to restore the mineral balance in the soil and to renew poor or degraded soils [33,34]. Melo et al. [35] suggest basalt powder for soil amendment as an alternative to reduce production costs and improve crop productivity. Moreover, Osterroht [36] and Silva et al. [37] claim that the basalt powder stays longer in the soil solution with gradual release of nutrients consistently with the plant development [36,37].

The current study aims to assess the effect of different botanical and mineral biopesticides on the plant parameters development, then their efficiency in cereal pest management. The pests that were the subject of trials were thrips, aphid and cereal leaf beetles with *Haplothrips tritici*, *Rhopalosiphum padi* and *Oulema hoffmannseggi* respectively as dominant species.

## MATERIAL AND METHODS

**Vegetal and mineral material.** Four plants were chosen to be used in the experiment as bioinsecticides; which are carob *Ceratonia siliqua* L. (1753), aleppo pine *Pinus halepensis* Mill (1768), oleander *Nerium oleander* L. (1753) and Bitter orange *Citrus aurantium* L (1753). Leaves of carob, aleppo pine, and oleander were collected from Djebal Zaghouan (36° 21′ 07″ N, 10° 06′ 43″ E). Fruits of bitter orange were collected from the fields of the High School of Agriculture of Mograne (ESA Mograne). The peeled zest of bitter orange and leaves of the other plants were dried in open area for several days and then grounded to powder (with particles of 0.5 mm).

Farina di Basalto® Type XF and Type XM, produced by Basalti Orvieto srl, were used in this work. The first one is composed of micronized particles with less than 20 µm while the second one is composed of micronized particles with Granulometry 50% < 0.5 mm (50% up to 2 mm).

These two types of " Farina di Basalto®" obtained through an industrial process. Raw material used for production of “Farina di Basalto®” comes from the Castel Viscardo deposit (TR) - Italy. It is a basic volcanic rock, which does not contain free crystalline silica, nor amiantiferous minerals or other substances harmful to environment or animal health. Micronized “Farina di Basalto®” is obtained by mechanical grinding of pure mineral, using ceramic tools, without addition of other minerals or substances, nor use of materials containing washing water with flocculants, or undesirable and harmful products in agriculture. Known for its fertilizing effects applied in agriculture, “Farina di Basalto®” contains natural elements such as Silicon, Aluminium, Potassium and Calcium. Silica (silicon dioxide) is the main component that characterizes Farina di Basalto® Type XF and Type XM with percentages ranging from 45% to 49% [38]. Physicochemical characteristics and the different components of basalt flour Farina di Basalto® Type XF and Type XM are presented in the Table 1 and Table 2 respectively.

**Doses and aqueous extracts preparation.** Concerning plants, the aqueous extracts (AE) are prepared by maceration for 24 hours from leaves or zest powder. The tested dose was in order of 50 g/litre of water (5%) [28]. Then, the mixture was filtrated to have an aqueous solution without impurities and waste. For the basalt powder, were used different formulates, basalt applied on the soil as a fertilizer (XM), basalt applied on leaves (XF), with following the same dose for all of them in order of 15 g/litre of water (1,5%) [28]. The aqueous extract of basalt powder is prepared momently during the treatment application.

**TABLE 1**
**Physicochemical characteristics of Basalt powder “Farina di Basalto®” of both Type XF and Type XM [38]:**

| Characteristic | Description |
|---|---|
| Solid physical state | Powdery |
| Water solubility | Not soluble in water |
| Color | Slightly gray |
| Odor | Not noticeable |
| pH | 9±0.5 |
| Electrical conductivity (2:1 extract) (dS /m) | 1.14 |
| Cation exchange capacity (meq/100g) | 9 |
| Assimilable iron (As. Fe) (mg/kg) | 377 |
| Density (kg/dm$^3$) | 2.70 |

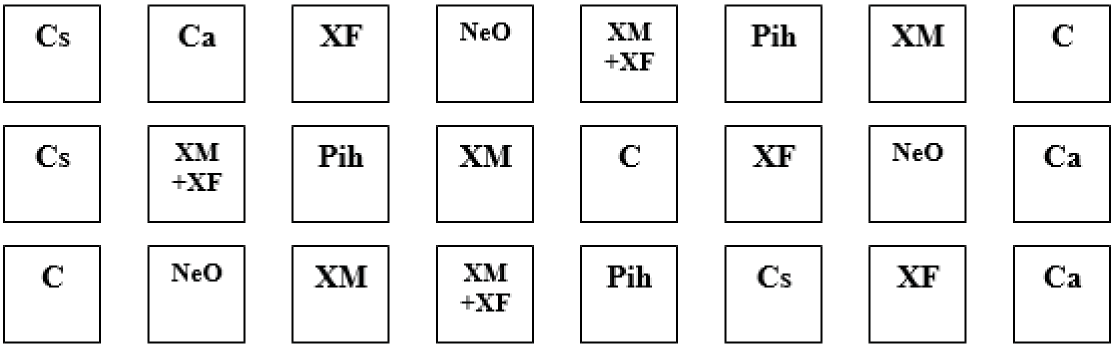



**FIGURE 1**
**pattern of the experimental design of aqueous extracts treatments**
C = Control; Cs = *Ceratonia siliqua*; Ca = *Citrus aurantium*; NeO = *Nerium oleander*; Pih = *Pinus halepensis*; XM = Fertilizing Basalt; XF= foliar Basalt; XM+XF = combined Basalt.

**TABLE 2**
**Chemical proprieties of Basalt powder Farina di Basalto® of both Type XF and Type XM [38]:**

| Component | (%) |
|---|---|
| $SiO_2$ | 45 - 49 |
| $Al_2O_3$ | 20.5-25.6 |
| $K_2O$ | 8-10 |
| $Fe_2O_3$ | 5.2-8.5 |
| CaO | 7.5-8.5 |
| MgO | 1.9-2.6 |
| $Na_2O$ | 2.2-4.9 |
| $P_2O_5$ | 0.6-0.7 |

**Treatments and experiment design.** The experiment was carried out on an attacked field of barley belonging to the High School of Agriculture of Mograne. The experimental pattern was divided into blocks. The experimental design is a complete random block (CRB). Each block is 20 m (length) by 5 m (width). The different treatments were as following; control (C), Carob (Cs), oleander (NeO), Aleppo pine (Pih), bitter orange (Ca), basalt applied on the soil as a fertilizer (XM), basalt applied on leaves (XF) and basalt applied combinedly on soil and leaves (XM+XF). Every treatment has 3 replicates, and their distribution was random (Figure 1).

A period of survey before treatments' application; that extended from 10 March 2023 to 19 April 2023, was intended to evaluate the attack of pests on barley. This period was necessary to decide when to launch pest management experiment. Spring is the appropriate season of the highest attacks of different pests on barley. First treatment (T1) was applied on 19 Mars 2023. Second treatment (T2) was applied on 10 Mai 2023. Follow-up of pests' populations and plant morphometric parameters after each treatment were conducted after 24 hours (1 day), 4 days, 7 days and 21 days. Assessment was carried out by sampling 10 barley plants from each block with one sweeping net.

**Growth stage of plants during the treatments.** The experiment was conducted from the tillering (GS21) to the full rip stage of barley (GS89). The survey period extended from the tillering to the boot stage. The first and the second treatments (T1, T2) was applied during the boot, the flowering, and the ripening stages.

**Evaluation of morphometric parameters.** Morphometric parameters that measured to identify effect of treatments on plants during the experiment were roots weight (RW) and length (RL), stem length (SL) and leaf area (LA). For length of stem and root (cm), they measured in millimetre (mm) by a measuring stick. The roots were weighed in gram (g) by a precision balance (0.001g). The leaf area was estimated in square millimetre (mm²) by a computer coordinating area-curvimeter.

**Efficacy and mortality rates.** Efficacy of aqueous extracts was evaluated using the Abbott's formula [39]:

$$\text{Efficacy } (\%) = (T_0 - T_t / T_0) \times 100$$

With $T_0$ (control) = number of alive insects on untreated plants; Tt = number of alive insects on treated plants.

Mortality was calculated and corrected according to the Sun-Shepard's formula [40]:

$$\text{Mortality } \% = ((M_T \% \pm C_C \%)/(100 \pm C_C \%)) \times 100$$

With $M_T$%: Mortality % in treated plot; $C_C$%: Change % in control plot population.

**Statistics analysis.** The analysis data was made by SPSS statistical software version 24. to compare means by Duncan's test and independent t-test (at p<0.05).

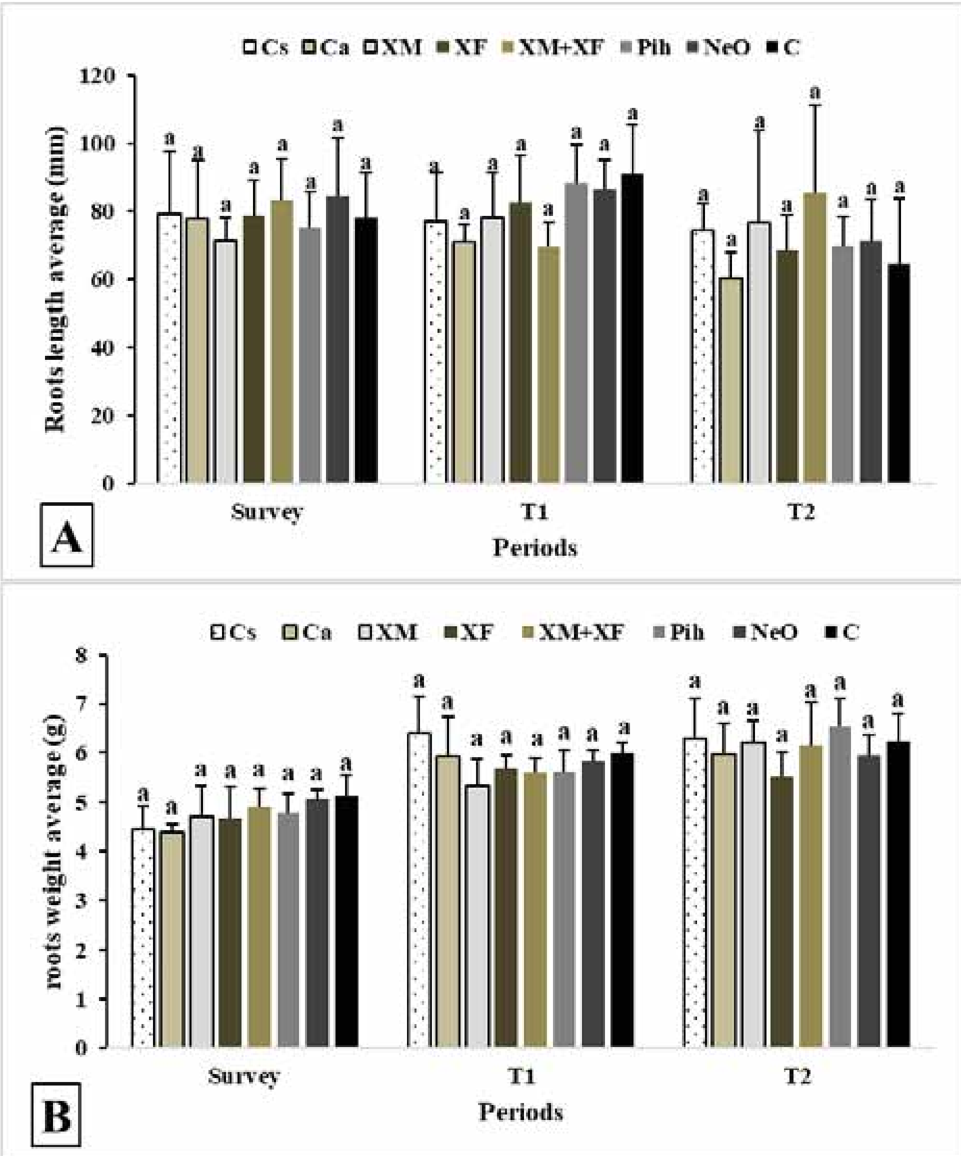
## RESULTS

**Study of evolution and effect of different aqueous extracts on barley morphometric parameters.** Results of RL, RW, SL and LA (Figure 2) illustrate that there is no significant difference (p>0.05) between control C and basaltic and botanical aqueous extracts during the survey, T1 and T2. The development parameters of aqueous extracts indicate no sign of toxicity or burning. Thus, these aqueous extracts do not enhance or inhibit the growth of barley plants. In fact, the aqueous extracts did not inhibit the normal rhythm of plant development.

**Aqueous extracts' effect on cereal pests.** The period of survey was important to reveal the accurate period for treatments application. As soon as pest populations started to increase, the aqueous extracts were applied on plants. It is a preventive management.

Before T1, thrips populations (Figure 3) had begun increasing especially in treatment plots. Control population increased during trial period. After treatment application, thrips populations of treated plot had increased after T1 with slight decrease before and after T2.

Mortality results (Figure 4-A) showed that all aqueous extracts had similar effect during T1 (ddl=6, F=0.86, p=0.53) and T2 (ddl=6, F=0.61, p=0.72). Lethal effects of aqueous extracts were higher in T1 than T2. Aqueous extracts were efficient to decrease radically the thrips population during T1 while T2 was to enhance the first treatment effect. After T1, highest mortality rates recorded in Pih followed by XF, XM+XF and Cs reaching 76.94, 75.38, 75.20 and 73.39% respectively. For T2, XM+XF has recorded highest mortality rate with 40%.



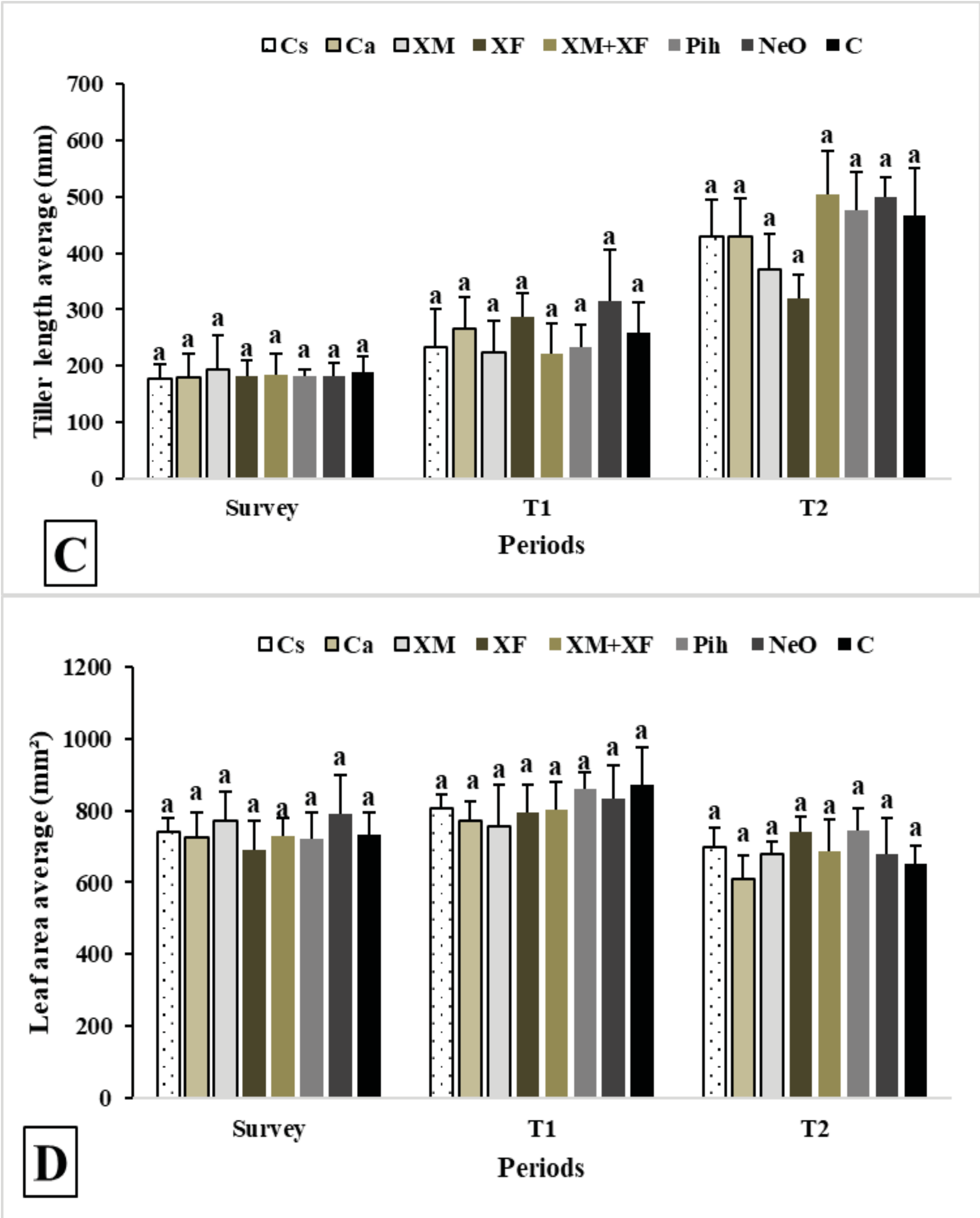



**FIGURE 2**
**Effect of different plant aqueous extracts on roots length (A), roots weight (B), stem length (C) and leaf area (B).**

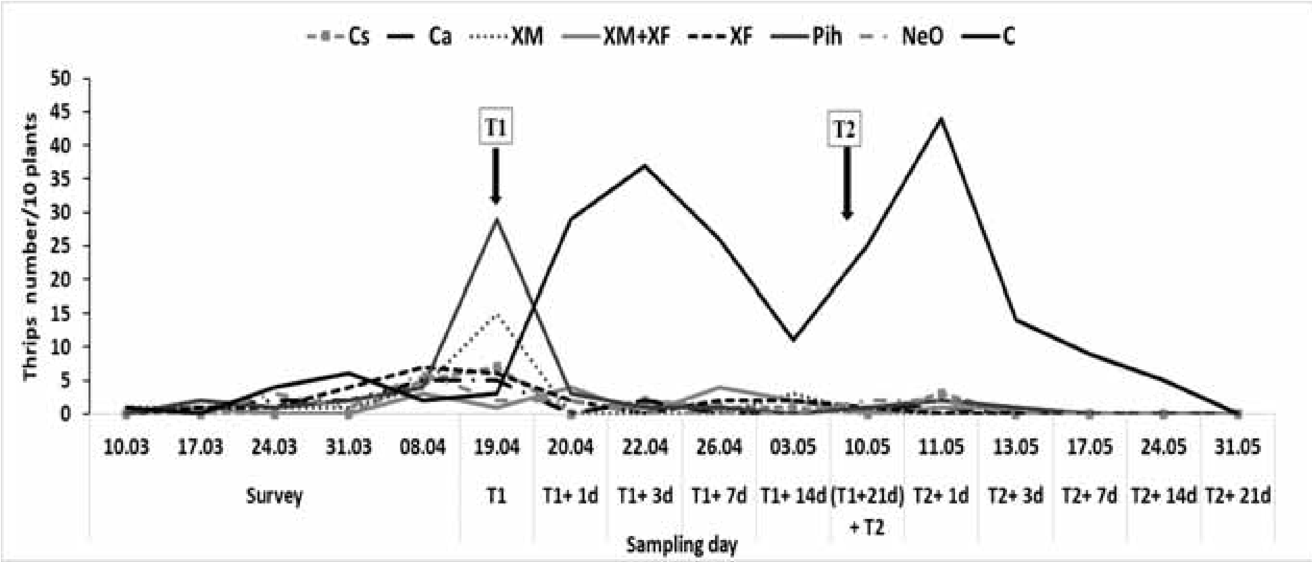



**FIGURE 3**
**Evolution of thrips' population of aqueous extracts and control plots during survey and after treatments T1 and T2 from Mars 10 to May 31, 2022**

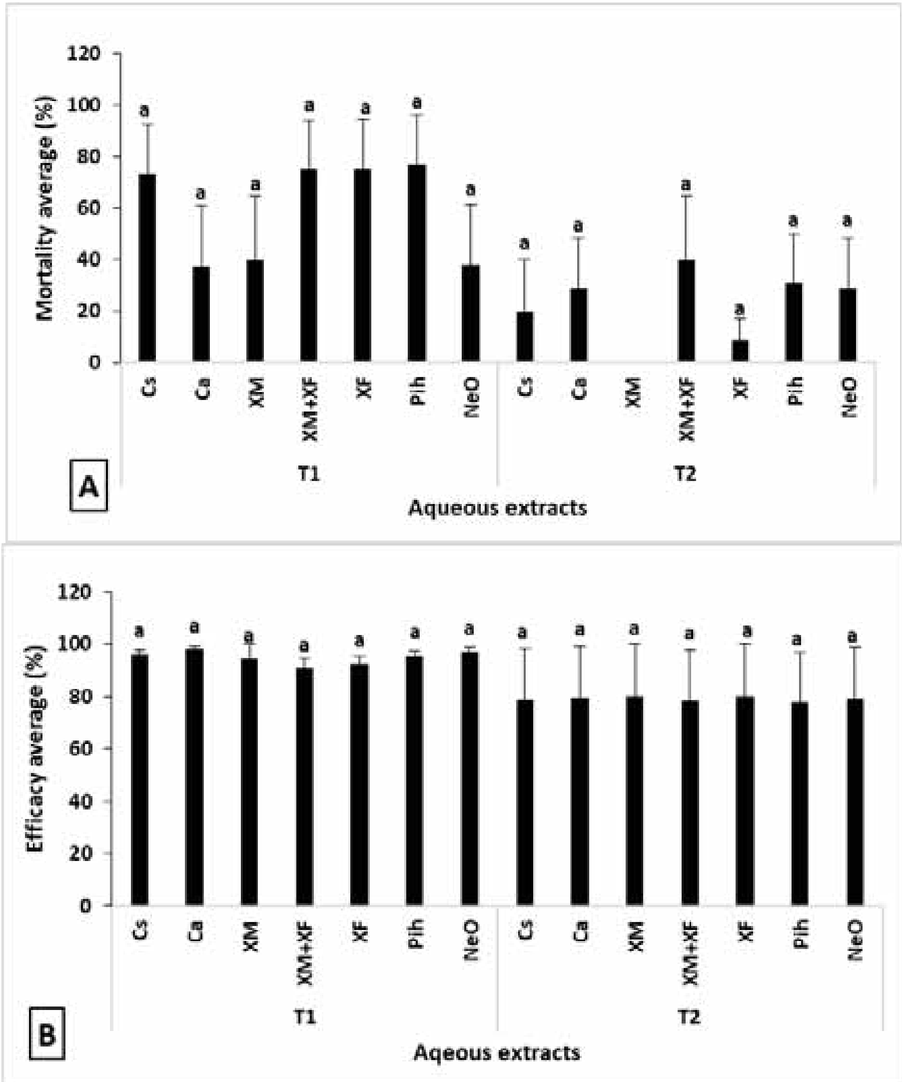



**FIGURE 4**
**Effect of aqueous extracts of treatments T1 and T2 on thrips' population; A: mortality average (%); B: efficacy averages (%)**

Efficacy results (Figure 4-B) approve that the different aqueous extracts inhibit multiplication of thrips populations. There is no significant difference between efficacy rates of tested extracts during T1 (ddl=6, F=0.76, p=0.61) and T2 (ddl=6, F=0.002, p=1). Efficacy rates of aqueous extracts were around 95% and 79% during T1 and T2 respectively. Aqueous extracts' effect can be the result of repellent activity.

Concerning aphids (Figure 5), populations were very fluctuant along time. Population recovery was fast and important after T1. Aphid numbers of control and aqueous extracts decrease after the second treatment T2.

Results show that mortality rates of aqueous extracts (Figure 6-A) were not significantly different during T1 (ddl=6, F=0.86, p=0.74) and T2 (ddl=6, F=0.13, p=0.99). Lethal effects of different used extracts were high during T1 than T2. This result can be explained by the coincidence of T2 application with a natural decrease of aphid population observed in control plots. It still that aqueous extracts were efficient to reduce aphid populations. The highest mortality rates during T1 were recorded in plant extracts NeO and Cs followed by basaltic extracts XF and XM+XF with 46.60, 44.21, 39.83 and 34.66% respectively. XM and Pih had recorded the highest rates during T2 with 35.20 and 27.62% respectively.

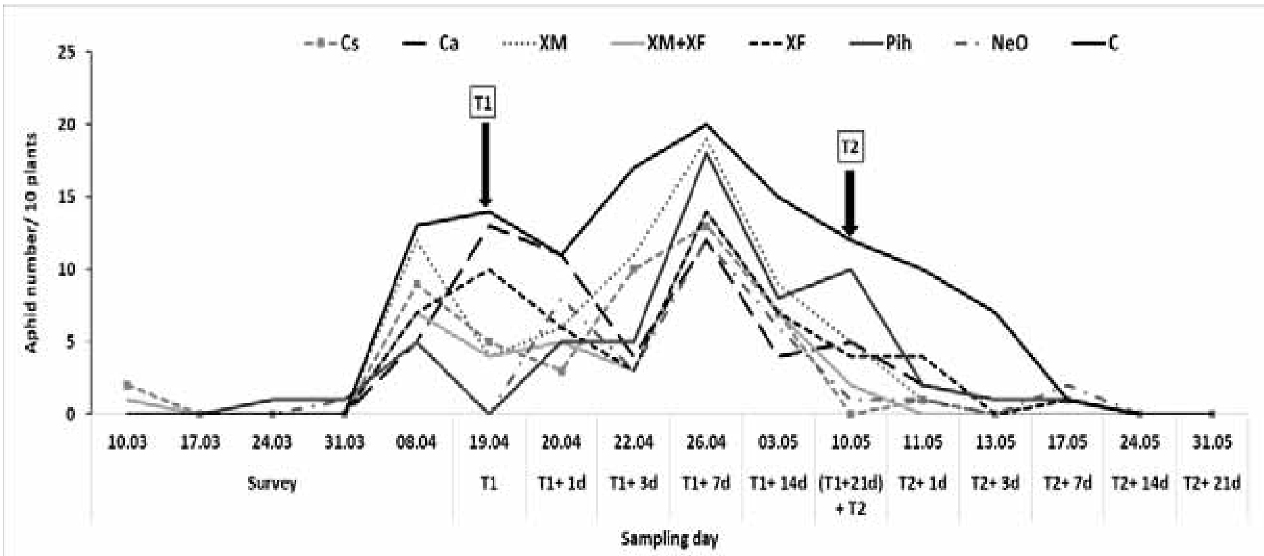
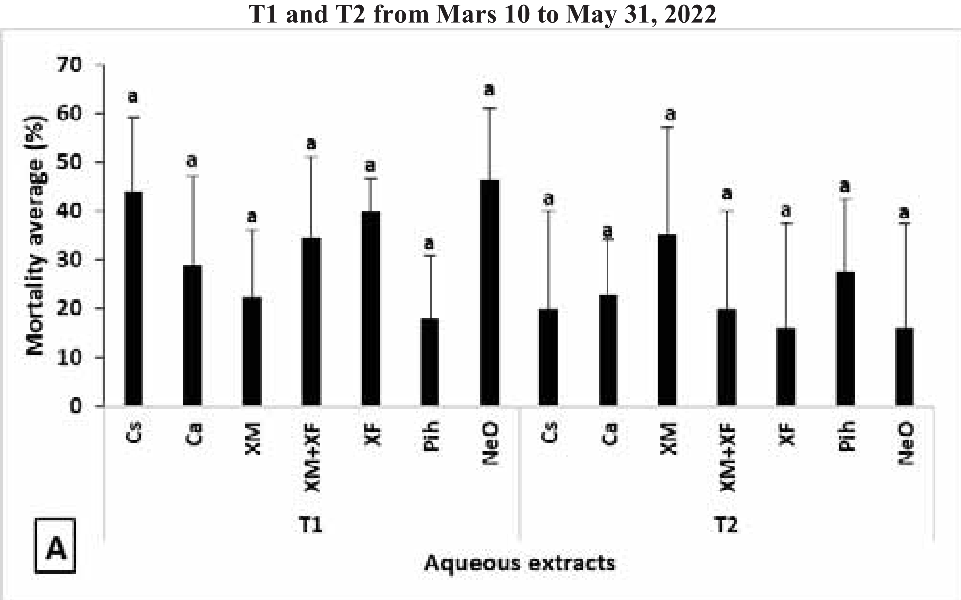



**FIGURE 5**
**Evolution of aphid' population of aqueous extracts and control plots during survey and after treatments T1 and T2 from Mars 10 to May 31, 2022**



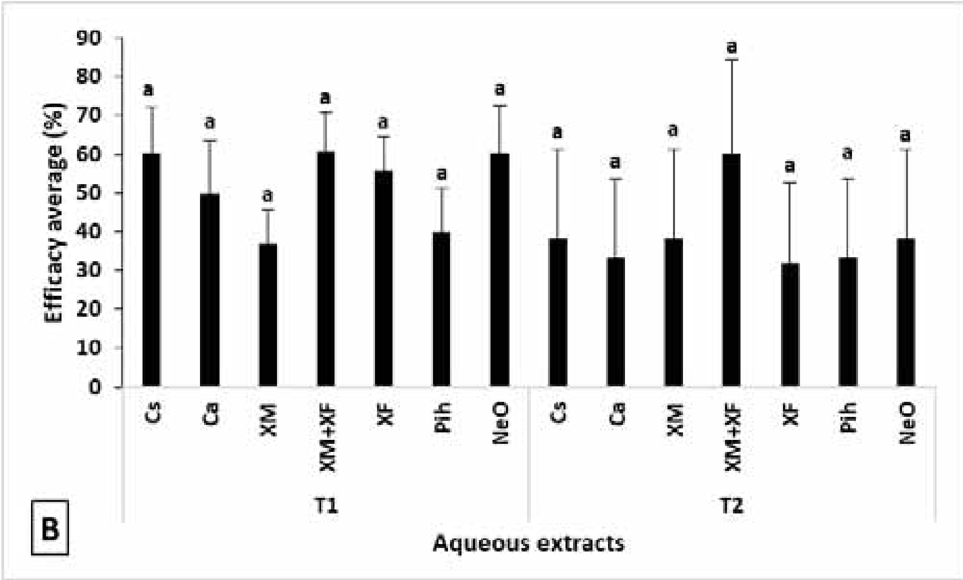



**FIGURE 6**
**Effect of aqueous extracts of treatments T1 on aphid' population; A: Mortality average (%); B: efficacy averages (%)**

Similarly, there is no significant difference between the efficacy rates of different extracts (Figure 6-B) during T1 (ddl=6, F=0.82, p=0.56) and T2 (ddl=6, F=0.19, p=0.98). Aqueous extracts were able to reduce the numbers of alive aphids and their multiplication. After T1, extracts XM+XF and Cs were the most relevant against aphids with 60.71 and 60.45% respectively; followed by 60.26% for NeO and 55.56% for XF. After T2, XM+XF recorded the highest efficacy with 60%. Mortality and efficacy rates of aqueous extracts against aphids were lower than those recorded for thrips. These finding can be due to the high multiplication capacity by parthenogenesis which can be the factor of fast population recovery. Simultaneously, aphids are soft body insects which susceptible to insecticide. This criterion explains fast reduction of their population following certain treatment application.

For cereal leaf beetles (Figure 7), control population (C) increased progressively till the end of trial period. Population of treated plots increased before first treatment application T1 and slightly before second one T2 in Ca, Pih and Neo plots. In general, cereal leaf beetles of treated plots greatly decreased after treatment T1.

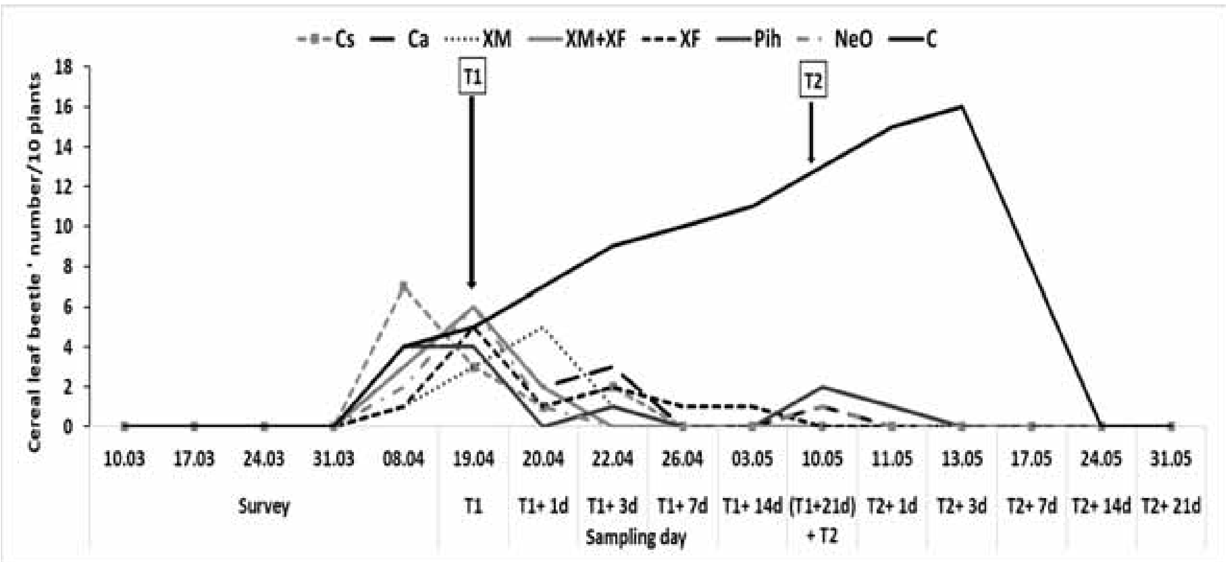



**FIGURE 7**
**Evolution of cereal leaf beetles' population of aqueous extracts and control plots during survey and after treatments T1 and T2 from Mars 10 to May 31, 2022**

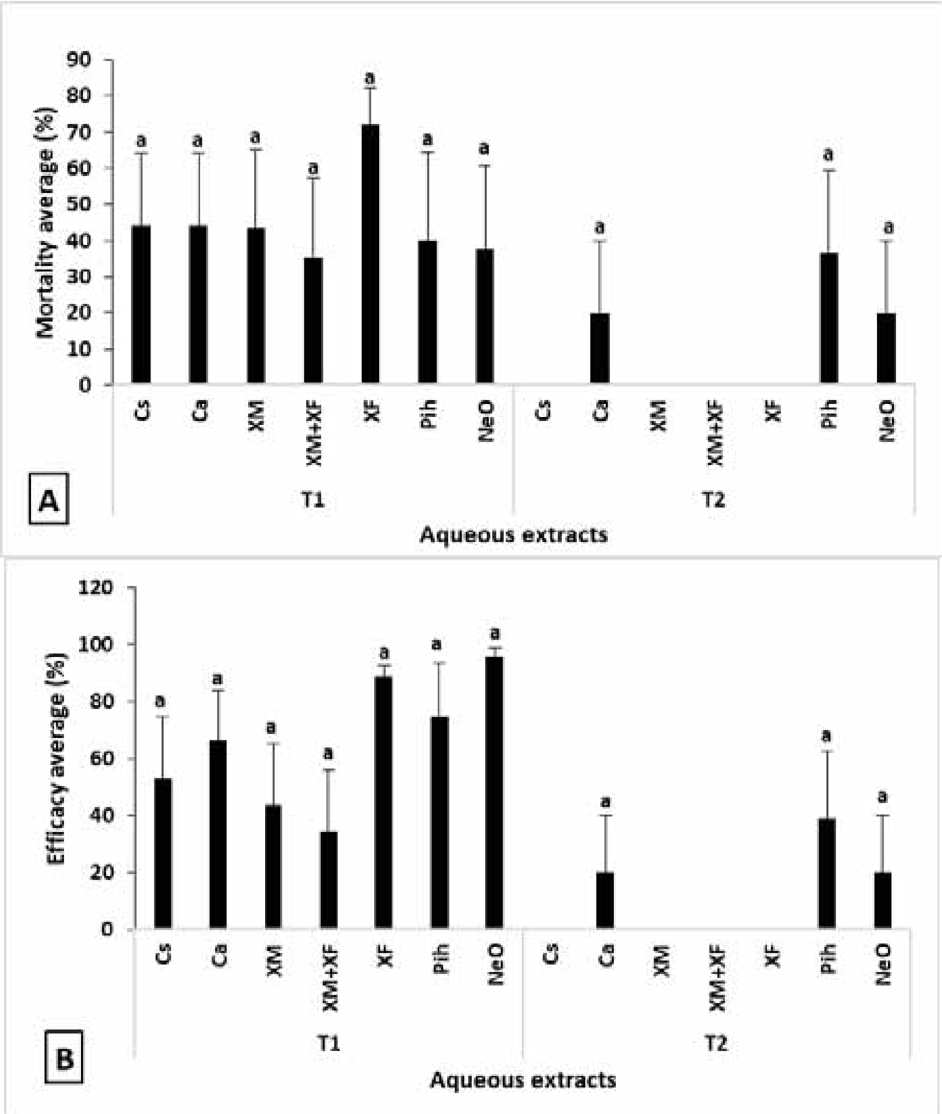



**FIGURE 8**
**Effect of aqueous extracts of treatments T1 and T2 on cereal leaf beetles' population; A: Mortality average (%); B: efficacy average (%)**

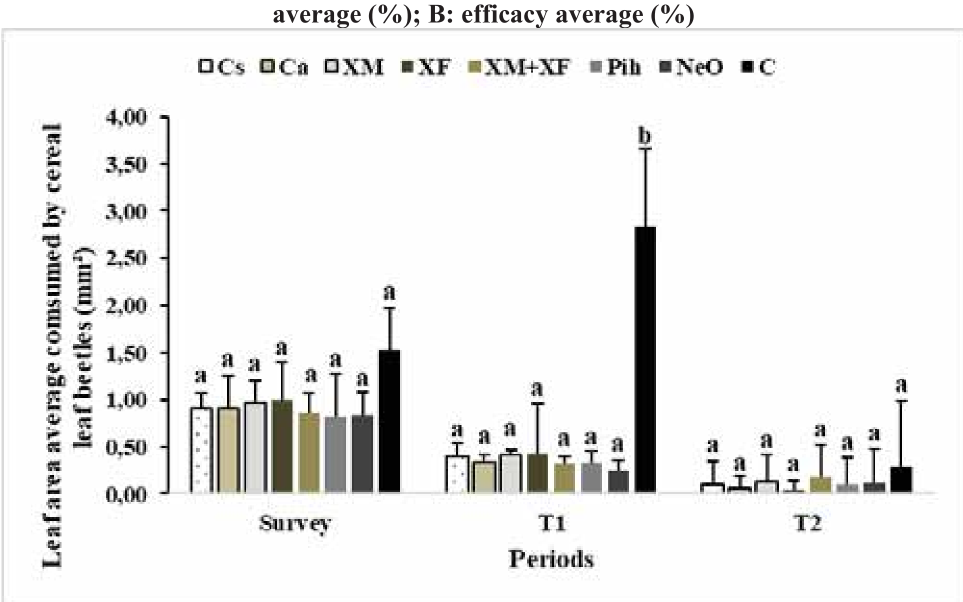



**FIGURE 9**
**Effect of different plant aqueous extracts on leaf area consumed by cereal leaf beetles.**

All extracts did not exhibit a significant difference between their mortality rates (Figure 8-A) during T1 (ddl=6, F=0.35, p=0.90) and T2 (ddl=6, F= 1.16, p=0.36). All extracts had high lethal effect on cereal leaf beetles' populations. The greatest mortality rates were recorded for XF during T1 with 71.94% and Pih during T2 with 36.67%.

Also, there is no significant difference between the efficacy rates of different extracts (Figure 8-B) during T1 (ddl=6, F=1.76, p=0.14) and T2 (ddl=6, F=1.21, p=0.33). Aqueous extracts were able to reduce the numbers of alive cereal leaf beetles and their multiplication especially by its lethal effect on larvae and repellent effect on adults. Extracts Neo, XF and Pih had exhibited the highest efficacy rates during T1 with 95.60, 88.88 and 74.70% respectively while Pih was the most efficient during T2 with 38.67%. Vegetal and basaltic aqueous extracts against cereal leaf beetles were efficient to reduce their population from the first application T1 and the second application T2 was for prevent their population recovery.

Beetle damage on barley leaves was also evaluated (Figure 9). Aqueous extracts showed a highly significant effect during T1 (ddl=7, F=34.80, p=0.00) on reduction of beetles' consumption of leaves. This leads us to conclude that these extracts prevented this pest from feeding when consumed leaf surface continues to increase in C. Control confirm that consumed leaf area average increased from 1.54 mm² during survey period up to 2.84 mm² during T1. This increase is due to the increase in number of individuals of beetles installed on plants. These aqueous extracts seem to reduce the appetite of beetles to consume barley leaves by larval mortality and starving or adult repellent effect.

## DISCUSSION

During the bioinsecticides trials, the vegetal and basaltic aqueous extracts have not inhibited normal development of barley plants and do not caused necrosis. During a study carried on *Citrus* peel blemishes on Kinnow mandarin in Pakistan along two years, nonchemical approaches based on Horticultural mineral oil (HMO) were used to manage pest causing blemishes [41]. It approved that the best performed treatment was a dose of 1.5% HMO coupled with improved pruning ICMP (removal of 5% additional biomass along with standard pruning practice) during first year. The overall results revealed a significant increase in the percentage of unblemished and low-blemished fruit by reducing insect pest population. Also, treatment improved fruit quality [41]. Comparing different doses, only fruit diameter among physical parameters was statistically improved by (1.5% HMO + ICMP) treatments compared with control. Among biochemical parameters, the highest vitamin-C contents were found in 1.0% HMO + ICMP. Non-reducing and total sugars contents were statistically highest in the fruit harvested from the trees subjected to 0.5% HMO application. No sign of phytotoxicity was observed in terms of leaves burning, leaves and fruit drop, etc. During second year, the best performed dose (1.5% HMO) were revaluated. Only fruit diameter and TSS (total soluble solids) were improved comparatively to control [41]. Researches made on basaltic effect on plant development as a fertilizer approved that the mineral was relevant to restore soils fertility, to increase plant growth and total yield. It was efficient also to improve fruits quality, some chemical constituents and chlorophyll rate of acacia, pepper fruits, tomato and cucumber than in untreated soils with basalt [42–44]. The dioxide silicon is considered to be the main cause of the greatest root and structural development of plants [45]. Basalt powder fertilization results in increased plant size, root system growth and dry mass plants [32,44,46]. The increase in chlorophyll and carotenoid after basalt powder treatments [32,44,47] may be related to the high concentration of silicon available in the soil [47] and the magnesium amount present in its composition [32].

Other than the development parameters of barley, the preventive applications of the aqueous extracts of mineral and botanical materials were highly efficient not only to reduce population of barley pests; thrips, aphids and cereal leaf beetles but also their damage. The most effective botanical extracts were those of carob (Cs) and oleander (Neo). Eight concentrations of crude aqueous extracts of *Nerium oleander* leaves were tested for larvicidal activities against 3rd and 4th instars of *Thaumetopoea wilkinsoni* Tams (1926). The highest larvicidal activity recorded with $LD_{50}$ value of 322.50 ppm and 190.00 ppm after 24 and 48 hours respectively [48]. Other experiments showed that *N. oleander* was used to control some pests and vector species such as mosquitoes [49–51].

Many researches showed that different parts of *N. oleander* as roots, stem, leaves and flowers have an insecticidal and antifeedant activities against *Plutella xylostella* [52–54]. Furthermore, oleander recorded a lethal activity against larvae and adults also ovicidal, insect growth regulatory activity and repellent activity [28,54–61]. Oleander extracts were effective to manage pest population as *Aedes aegypti* [57], *Culex quinquefasciatus*, *Anopheles stephensi* [55], *C. gelidus*, *C. tritaeniorhynchus* [59], *A. stephensi* [60], *Paederus fuscipes* [54], *Ceratitis Capitata*, *Phyllocnistis citrella* [28], *Rhyzopertha dominica* [61] and *Bemisia tabaci* [56,58]. The constituents Neandrin, Neritaloside, Odorside and Oleandrigenin are the toxic components of oleander extracts which can inhibit larval growth and feeding capacity of pests [16,62,63].

Also *Citrus* species were used in pest management. Peel oils of various *Citrus* species; *Citrus limon* L., *C. sinensis* L., *C. paradisii* L., *C. crassifolia* L., *C. reticulata* L.; which were extracted by hexane as solvent, recorded significant insecticidal effect against *Sitophilus oryzae* (L.) and *Callosobruchus maculates* (F.) [22]. Those of *C. aurantifolia* L., *C. sinensis* L., and *C. paradisii* L. that extracted using benzene as solvent, had lethal effect as bioinsecticide against *Tribolium confusum* Jacquelin du Val and *Sitophilus granaries* L. [23]. Ethanol extracts of *C. sinensis* seeds and *C. aurantium* leaves approved toxic against female adults and 2nd instar nymphs of *Drosicha mangiferae* [64]. Peel aqueous extracts of *C. aurantium* showed lethal and repellent activity against *Ceratitis Capitata* and *Phyllocnistis citrella* [28]. An experiment testing extracts of fruit flavedo (peel), albedo, and flesh *C. aurantium* showed that only the flavedo part has bioactivity. Petroleum ether extract of *C. aurantium* flavedo has an insecticidal effect on *Bactrocera oleae* adults [65]. The bioactive component Limonoids which is present in citrus seeds has an antifeedant activity and inhibit the larval growth for numerous Lepidoptera pests [24,26]. Elimem et al. [28] have identified that the dominant component of *C. aurantium* was Hesperidin which is a flavonones, while the dominant one for *N. oleander* was Quercetinrutinoside (rutin). These components seem to be the bioactive molecules that cause toxicity and repellent effects against crops pests. Siskos [65] indicates that oven-dried peels of *Citrus* lose their bioactive components before extraction. These bioactive molecules are heat-sensitive and can be volatilized under high temperature [65]. For the same reason, all plant parts used during the current study were dried in open air in an ambient temperature in order to conserve their bioactive components.

Mineral aqueous extracts of basalt powder were also efficient to decrease the pests' populations. Groth et al. [32] found that the basalt sequential spraying induced about 50% reduction of insect incidence on treated lettuce plants. The reduction of pest insects in basalt powder treatments may be the result of the amount of silicon absorbed by the plant as monosilicon acid ($H_4SiO_4$) [66]. The silicon on vegetal cells will play the role of repellent wall forming a physical barrier preventing insect attacks. It can also change its chemical responses, increasing the synthesis of toxins or tannins that may act as inhibitors or repellents [66–70]. Like basalt, diatomaceous earths (DEs) are mainly composed of amorphous silica associated to fossilised remains of unicellular algae called diatoms [71]. This rock powder was known lethal for insect because its particles absorb the epicuticular lipids and cause water loss then desiccation and death [71–73]. Two doses of two Diatomaceous earths (DEs) with highly rate of silicon (92% $SiO_2$) were tested against the predatory mites *Blattisocius keegani* Fox and *Cheyletus malaccensis* Oudemans on wheat under three temperatures 20, 25 and 30 °C. Results showed that both species are susceptible to the two DEs tested especially at the highest temperature [74]. Previous researches claimed that hardness and abrasiveness of the particles dust are key factors to increase insecticidal efficacy of dusts against certain adult grain-infesting beetles [75–78]. Unless abrasive nonsorptive dusts are effective only when they are very finely divided. However, nonabrasive and highly sorptive powders are the most desiccant dusts [79,80]. Kaolin is another silicate dust that showed relevant to control phytophageous insects by forming a particle film and to protect plants from sunburn and heat stress [30,81–83]. Braham et al. [84] found that the Kaolin applications are sufficient for the control of *C. capitata* in Citrus orchards.

## CONCLUSION

Biological pest management is a sufficient and safe alternative increasingly recommended. The tested bioinsecticides of the four vegetal plants (carob, oleander, aleppo pine, and bitter orange) and basalt as mineral material, recorded a sufficient lethal and repellent activity against thrips, aphids, and cereal leaf beetles' populations. Also, the tested aqueous extracts were not toxic towards plants and showed a normal plant development during the management trials. The most efficient aqueous extracts were the foliar (Farina di Basalto® Type XF) and combined (Farina di Basalto® Type XM + Farina di Basalto® Type XF) basaltic extracts and botanical extract of carob (Cs) and oleander (NeO). Farina di Basalto® Type XF, because of its great adhesiveness, increase the persistence and the effectiveness of products mixed with. Farina di Basalto® Type XF itself offers protection; its mineral elements strengthen the plant and thicken its tissues. These bioinsecticides can be helpful to improve plant growth and metabolites quality and to limit pests' proliferation.

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