BNHC E-MAGAZINE

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BioNatural Healing College

Message: from the President of BioNatural Healing College (BNHC)

Greetings!

First and foremost, I am extremely thankful to Almighty God for granting me this opportunity to present the BioNatural Healing College (BNHC), BNHC E-Magazine to our dear readers. Also, I would like to thank you all, especially the dear readers who send us their valuable feedback and support. The information in this magazine is solely for educational purposes.

We hope this BNHC- E-Magazine will be useful to you based on the contribution and dedication of many other respected researchers and colleagues around the globe. Thanking and wish you all the best health and prosperous life.

Best regards,

Dr. Nadir Sidiqi Ph.D.

BioNatural Healing College

BioNatural Healing College Stands on Seven Core Pillar Foundations as follows:

1. All living organisms are made from the water this beautiful connection, connects us to praise the Creator of Creation for the provision of feeding, fueling, and healing to humanity.
2. No harm to public health and environmental health (Biodiversity) including pollinators, surface water, groundwater, soil, and air.
3. A series of complex chains involved with food production from the field to the mouth of the human body desperately needs scientific research to maximize healthy nutritionally food production and end malnutrition and food insecurity.
4. Harmful pests such as insects, and pathogens causing to human and plant health and loss of economic problems. BioNatural chemicals from plants, microorganisms, and ocean-living organisms exist and need further research to discover along with safety to utilize for the health improvement of humans as well as BioNatural Pest Management (insects, fungi, bacteria, various, nematodes, weeds, rodents, etc.).
5. Listen, love, appreciate, and respect with deep conscience and subconscious the connection between the genes of your body and beautifully ecologically in sense of feeling, feeding, fueling, and healing.
6. The brilliant human mind can irrigate with balance drinking clean water as a whole-body system to detoxify the toxicant from their body systems as well as to detoxify the soil, water, and environment from harmful chemicals, particularly pesticides through collaboration, and dedication from the individual, family, community, and scientific community locally and globally.
7. BioNatural Healing College provides a high-quality science base foundation through online education to fit and accommodate the needs of each prospective student for the sustainability and prosperity of his or her own, family, community, and humanity.

Nectar cover cropping for enhancing natural enemies and improving pest control in citrus orchards.

Dr. Nicola Irvin

Asian citrus psyllid (ACP; Fig. 1) is a sap-sucking pest that vectors a bacteria which causes "greening disease" in citrus trees. This disease causes the fruit to taste bitter and eventually kills the tree. Other sap-sucking pests of citrus are brown soft scale, California red scale, and mealybug (Figure 1). In California citrus, generalist predators such as hoverflies (Diptera: Syrphidae), coccinellid beetles, and lacewings feed on these sap-sucking insects (Fig. 2).

Life table and videography studies have demonstrated that hoverfly larvae cause significant mortality of the immature life stages of Asian citrus psyllid (ACP) (Kistner and Hoddle 2015; Kistner et al. 2017). Hoverfly larvae consume up to 93% of the immature stages of ACP so are an important natural enemy of this pest in California.

Parasitoids also play a significant role in controlling sap-sucking insects. An example of a parasitoid is the ACP parasitoid, *Tamarixia radiata* (Fig. 2). This tiny wasp lays its egg on the underside of ACP nymphs, the resulting wasp larva eats the nymph, eventually killing it. While generalist predators attack a wide variety of pests, parasitoids are species-specific. There is a different parasitoid species for each of the pests in Figure 1.

Figure 1: Four key pests of citrus trees in California orchards.

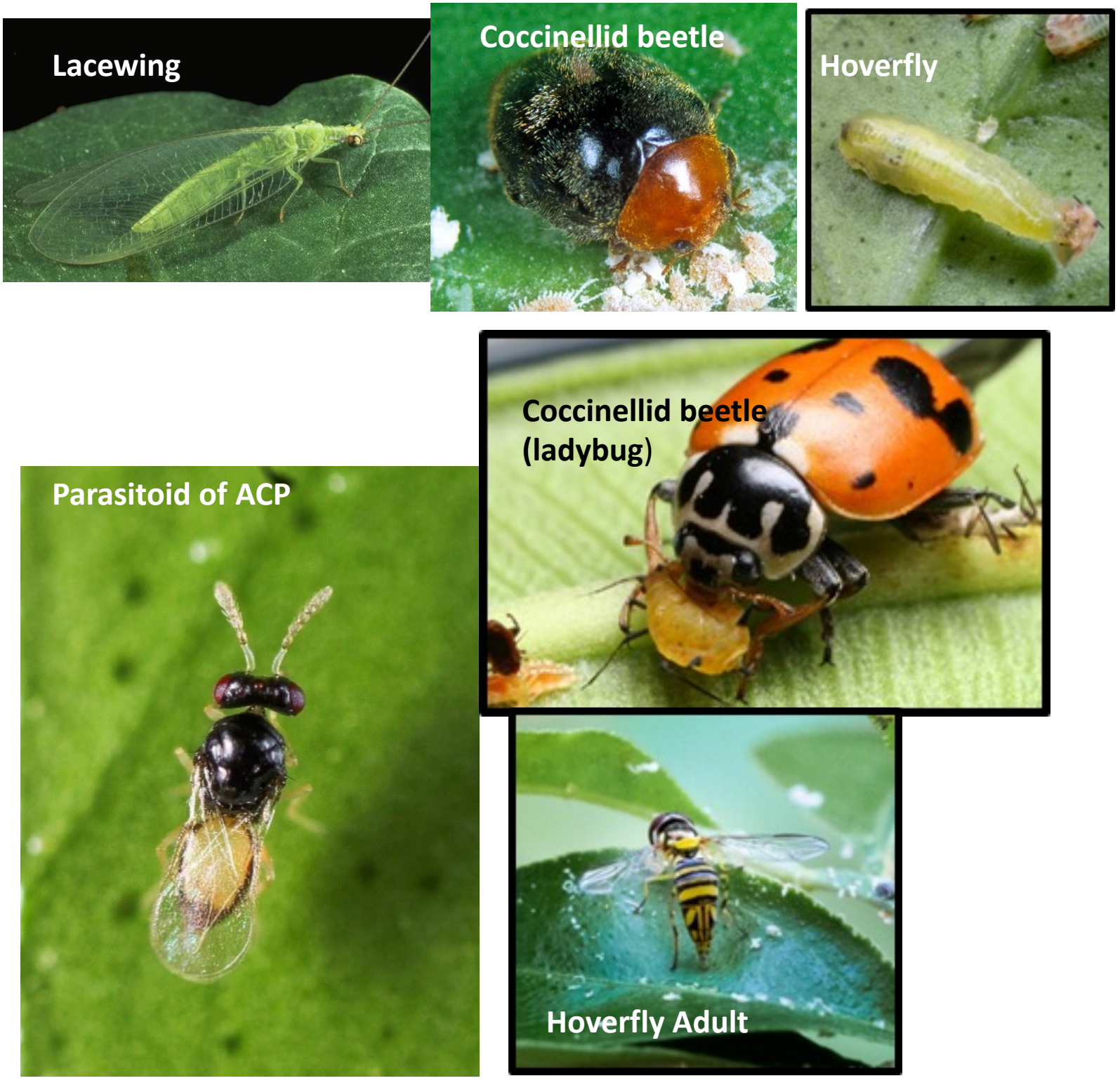

Figure 2: Natural enemies of sap-sucking pests in citrus orchards.

How can we make these natural enemies more efficient at controlling sap-sucking pests in citrus orchards? Many adult natural enemies require pollen and/or nectar for survival, host-seeking, mate-finding, and egg maturation. Hoverfly larvae are predacious, while adults can only feed on nectar and pollen (Fig. 2). Most citrus growers in California use herbicides to remove weeds throughout the orchard so the weeds don't compete with the crop for water and nutrients. However, this decreases the biodiversity in the orchard and removes potential floral resources, therefore making the orchard an unfavorable habitat for natural enemies (Fig. 3).

Figure 3: A typical citrus orchard in southern California uses herbicides to remove weeds.

Attract and Retain Natural Enemies using cover crops

Incorporating a flowering cover crop in orchards and vineyards is one way to enhance natural enemy populations by providing shelter and food (Fig. 4). This strategy aims to "attract and retain" natural enemies and enhance their fitness, leading to improved pest control (Liang and Huang 1994; Silva et al. 2010).

Figure 4: Examples of cover cropping in orchards and vineyards for enhancing natural enemies and improve pest control. Left: Alyssum growing in a citrus orchard in Redlands, CA; Middle: Mustard growing in a vineyard in Napa valley, CA; Right: Buckwheat growing in a vineyard in Temecula, CA.

Figure 5: From left California poppy (*Eschscholzia californica*), phacelia (*Phacelia tanacetifolia*), common buckwheat (*Fagopyrum esculentum*) and sweet alyssum (*Lobularia maritima*).

Not all flowers are beneficial to natural enemies. The floral cups of some flowers contain hairs which may deter natural enemies from crawling down the corolla and accessing the nectar. It is also important to select cover crops that have flowers with shallow corolla so the nectar is accessible to a wide range of natural enemies. In 2018 research conducted by Hoddle Lab investigated which flowers are most attractive to natural enemies of citrus pests. Plants tested were California poppy, phacelia, common buckwheat and sweet alyssum (Fig. 5). Results demonstrated that alyssum and buckwheat were attractive to four predatory hoverfly species with 10-20 times more feeding hoverflies observed on these plants compared to that on California poppy (Fig. 6). No hoverflies were observed feeding from phacelia (Fig. 6), which may be attributable to phacelia having deep floral cups, thus preventing nectar access to hoverflies.

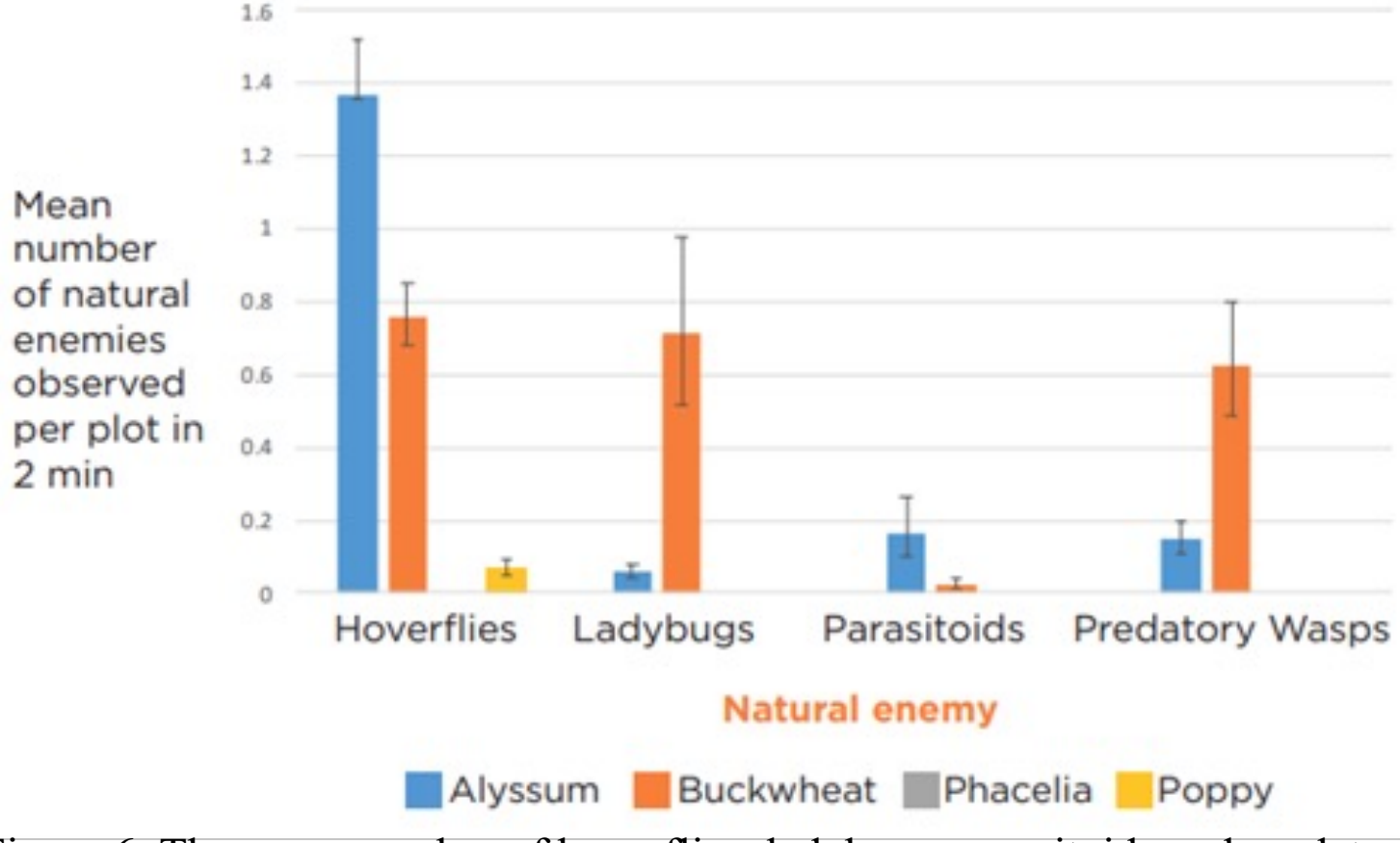

Figure 6: The mean number of hoverflies, ladybugs, parasitoids and predatory wasps counted in flowering alyssum, buckwheat, phacelia and California poppy plots at UCR during two-minute observations every two to four days between April and August 2018.

Further experiments were conducted to investigate the effect of incorporating potted alyssum into citrus orchards for two weeks and deploying small potted citrus trees infested with known numbers of ACP (Fig. 7). The alyssum remained in the field while the ACP nymphs developed into adults. Hoverfly oviposition, predator abundance, and nymph survival was compared between alyssum and control plots. Results showed that the number of hoverfly eggs laid on the potted citrus plants and the abundance of predators (88 percent of which were hoverfly larvae) were 3.5 times and 2.5 times higher, respectively, on potted citrus plants deployed in alyssum plots compared with control plots lacking alyssum. Additionally, 10% more nymphs survived to adulthood in the control plots compared with plots containing potted flowering

Figure 7: Experimental setup of plots containing potted alyssum and small potted Citrus plants infested with a known number of Asian citrus psyllid; Inlay: Allograpta oblique hoverfly drinking nectar from alyssum flower.

Fig. 8: Buckwheat and flowering alyssum planted in the tree line of experimental cover crop plots. Yellow sticky trap monitoring natural enemies.

In 2021-22 we extended this research by determining where and when to sow cover crops for improved pest control, and investigating whether providing a nectar cover crop from April through November can lead to increased pest control of sap-sucking pests. In cover crop plots, buckwheat and alyssum were sown in the tree line on February 28th, 2022, and sprinkler irrigation to water the cover crop was installed from the existing citrus tree irrigation (Fig. 8). Staggered sowings extended nectar availability through November 2022. Control plots contained no cover crops. Yellow sticky traps were placed in buckwheat and control plots to monitor predators such as adult hoverflies, ladybugs, and lacewings (Fig. 8). Two min visual counts were conducted to monitor hoverfly adults. Foliage samples were removed from trees and the number of pests (scale, mealybug, and Asian citrus psyllid) and natural enemies (such as hoverfly eggs and larvae) on the foliage samples were counted under the microscope. We aim to determine whether our cover crop treatment enhances the abundance of hoverflies and decreases pest numbers compared with control plots. This would indicate cover crops are a good Integrated Pest Management tool for California citrus growers.

The idea of incorporating flowering plants into agricultural landscapes can apply to many cropping systems and also home gardens, too. In home landscapes, the activity of natural enemies is often disrupted through use of pesticides, changes in land management practices, and lack of habitat that is favored by natural enemies. The primary strategies homeowners can employ to conserve natural enemies in the landscape are to (1) reduce pesticide use by trying alternative control strategies, using selective chemistries, and limiting applications to only infested plants; and (2) incorporate flowering plants to attract, retain and enhance natural enemies (Fig. 9).

Figure 9: Potted alyssum ready to be planted in a home garden.

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1. **Herbal Science & Master Herbalist**
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3. **BioNatural Pest Management**
4. **Nutrition & Brain Function**
5. **BioNatural Health Practitioner**

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Location: Pomona, California

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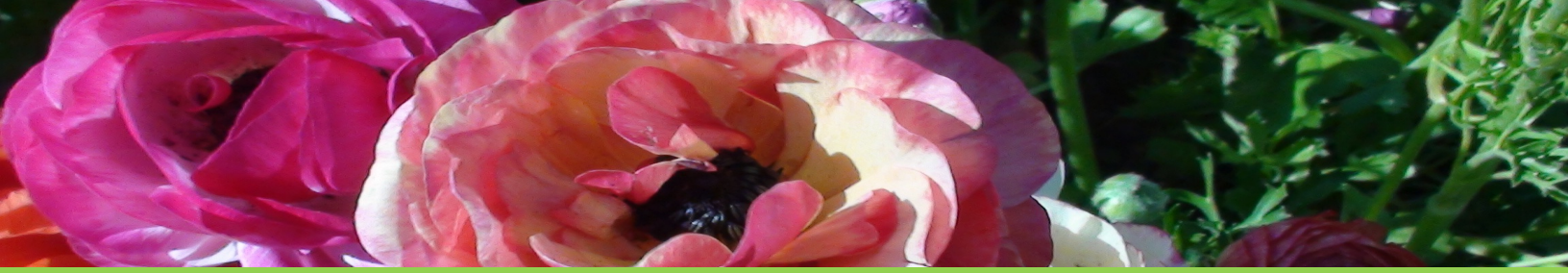

Mission: BioNatural Healing College is a non-profit public benefit institution that has tax-exempt status under the Internal Revenue Service, Section 501(c)(3) of the United States of America. Our goal is to offer a high-quality education a diploma program as well as holistic health and nutrition conferences, seminars, workshop, and continuing education. The focus of these educational programs is to offer healing and holistic nutrition science through online distance learning. These dynamic online education programs will provide diverse adult learners throughout the world the experience of enhancing their quality of life, their health, and their happiness.

Vision: The faculty, staff and management team of BioNatural Healing College are passionately committed to providing the best teaching possible in this field. We seek to encourage, motivate and explain the importance of this field to prospective students so that they may make an informed decision regarding enrollment. We seek an ultimate goal of satisfaction for the student based on responsibility, commitment, respect, awareness and sustainable education for society.

Accreditation and Recognition: BioNatural Healing College is based in California. It is an institution that has the goal to deliver on- demand online distance learning around the globe. This education is of high quality and vocational in nature. BioNatural Healing College is a legal business entity that has been approved to operate by the State of California's Bureau for Private Postsecondary Education that set forth in the educational code. BioNatural Healing College is not accredited by the United States Department of Education. BioNatural Healing College is a member of the American Holistic Health Association (AHHA).