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Enhancing the Population of Beneficial Arthropods in Pummelo (*Citrus Maxima*) Orchard Using *Arachis Pintoi* as Cover Crops

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Abstract: *Enhancing the population of beneficial arthropods under less diverse agroecosystem is the most sought by biological control professionals. This strategy was done through the establishment of Arachis pintoi as cover crop in pummelo orchard of the University of Southeastern Philippines (USeP), Mabini, Compostela Valley Province, Philippines. This study was conducted to compare population of beneficial arthropods in pummelo in with and without A. pintoi cover crop. Data collections were done for 12-month period (from June 2013 to May 2014) and were analyzed using the Independent Samples T-Test. Results revealed numerically and statistically higher density of important beneficial arthropods such as microhymenopterans, macrohymenopterans, spiders, tachinid flies and ground beetles were recorded in pummelo orchard with A. pintoi than from without cover crop for 12-month observation period. The study revealed that planting A. pintoi in pummelo orchard could enhance beneficial arthropod populations*

Keywords: *Arachis pintoi, cover crop, beneficial arthropods, pummelo*

1. Introduction

Biodiversity refers to all species of plants, animals, and microorganisms intermingling within an ecosystem [12]. Biodiversity prevents soil erosion, replaces ground water, and controls flooding by improving penetration and reducing water runoff. In agricultural ecosystem, biodiversity performs ecosystem services such as recycling of nutrients, control of local microclimate, regulation of hydrological processes, regulation of the abundance of undesirable organisms, and detoxification of noxious chemicals [1].

Modern agriculture has often created conditions favorable for pest populations, but unfavorable to beneficial arthropods [5]. This is very common in most monocultures where pest outbreaks are always happening that specialized insect species usually exhibited higher abundance in monoculture with no ground cover than in polycultures because of the reduced number of natural enemies [1].

Monoculture as the most common cropping system nowadays evidently lacks diversity and this can be enhanced by planting cover crops in the orchard. For instance, in California, cover-crop management has been recommended because ground cultivation enhances soil erosion, reduces water penetration, and modifies the summer microclimate unfavorably [6].

Studies have shown that plants mostly from the Family Leguminoseae play an important ecological role by not only improving soil physical and chemical properties but also harboring and supporting a complex of beneficial arthropods that aid in suppressing pest populations [2, 3] or had a direct impact to the pest population.

One of the most leguminous perennial that have been used as cover crops in most orchards nowadays is the pintoi peanut, *Arachis pintoi*. This legume has a good potential for use as living mulch in association with vegetables, trees or grass (forage crop) because of its ability to fix nitrogen from the atmosphere and to grow in heavy shade. This plant is also use for insect management where studies have shown that the leguminous plant significantly reduced the infestation of root weevil in citrus where the result leads to a polyculture solution for the pest problem [8].

In Davao Region, Philippines, several orchards have been planted with *A. pintoi* for weed control and beautification purposes but no studies has been done yet on the effect of this cropping practice to the beneficial arthropod populations, hence, this study.

This study will explore more on the effect of the *Arachis pintoi* as cover crops on the incidence of beneficial arthropod populations in pummelo orchard of USeP, Mabini, Compostela Valley Province, Philippines.

2. Methods

Site and Duration of the Study

This study was conducted at the pummelo orchard of the University of Southeastern Philippines (USeP), Pindasan, Mabini, COMVAL Province, Philippines from June 2013 to May 2014.

Treatments of the Study

This study was composed of two treatments: (1) pummelo with *A. pintoi* cover crop and (2) pummelo without *A. pintoi* cover crop. For each treatment, 1000 m^2 area was prepared and divided into 5 plots that will serve as the replication.

Establishment of *Arachis pintoi*

Arachis pintoi was established in the pummelo orchard before the actual start of the experiment was conducted. *A. pintoi* was collected within USeP vicinity that is free from diseases or insect pest damages. The stolons were cut using a sharp knife measuring approximately 20 cm height and planted in a slanting position buried 20 cm from the soil surface. A distance of 10 x 10 cm between rows and hills was done to allow faster coverage of the area. Watering was done particularly during sunny days as the stolons are sensitive to moisture loss particularly during establishment period. Likewise, good drainage was provided to drain excess water in the field to have a good stand of the leguminous cover crop. Replanting was done immediately for dead plantings. To enhance luxurious growth, a commercial foliar fertilizer was applied one month after transplanting and weed control using manual method was employed for the whole establishment period. Establishment period took 6 months before total coverage of the experimental areas.

Cultural Practices of the Experimental Trees

The experimental area except for plots with *A. pintoi* was cleaned by slashing the weeds with the use of sharp bolo and herbicide at 45 days interval of weeding. Watering was done when 20-30 cm of the top soil is dry. Fertilization of pummelo trees was done based from soil analysis at Regional Soils Laboratory, Agdao, Davao City, Philippines. Harvesting was done at proper stage of maturity, that is, 5 to 6 months after flowering. Care in harvesting was properly observed to avoid blemishes and other mechanical injuries.

Population of beneficial arthropods was monitored utilizing various traps such as yellow pan trap, pitfall trap, Malaise trap and sweeping method using standard insect net. For yellow pan trap and pitfall trap, five traps were installed in strategic location for each of the two treatments (with and without *Arachis pintoi*). For Malaise trap, one trap for each treatment was installed at the middle of the field. For sweeping method, five trials were made separately across the two treatments using 20 sweeps at 180 degrees angle.

Beneficial Arthropods Identification

Beneficial arthropods were identified using various references were that of Baltazar (1962), Borror et al., (1981), Pedigo and Rice (2006), IRRI (2000); specimens collected and displayed in Museum (department of Pest Management, Visayas State University, Visca, Baybay, Leyte, Philippines); and from various internet literatures. Confirmation of correct classification up to family level was done by consulting experts (insect systematists).

The data were analyzed using the Independent Sample T Test in SPSS.

3. Results and Discussion

The average population of common beneficial arthropods associated in pummelo under with and without *Arachis pintoi* cover crop is presented in Table 1. Moreover, the population dynamics of the beneficial arthropods for 12 months observation period is shown in Figures 1-5.

Result of statistical analysis revealed significant differences were observed on all beneficial arthropods collected. For microhymenoptera, significantly greater population was recorded in pummelo with *A. pintoi* cover crop than from without *A. pintoi* cover crop. The year-round presence of flower from the cover crop provide nectar source for the adult parasitoid to feed on, hence greater abundance of the mentioned beneficial arthropods was taken from the former treatment.

Similar observation for macrohymenopteran populations wherein pummelo orchard with *A. pintoi* cover crop had higher population of beneficial arthropods particularly from the families Ichneumonidae, Braconidae, Evaniidae, Vespidae, Apidae and Chalcididae.

Spider population was also enhanced by the addition of *A. pintoi* as cover crop in pummelo orchard as reflected by greater population of spiders from the families Oxyopidae, Salticidae, Thomisidae and Lycosidae.

Moreover, tachinid flies (Tachinidae) are more abundant in pummelo orchard with *A. pintoi* ground cover than from without cover. This imply that *A. pintoi* is an excellent cover crop by not only increasing the population of beneficial arthropods in the area but also improve the soil physical and chemical properties; increasing microfauna [9], and overall fertility of the soil [7].

The beneficial ground beetle (Carabidae) was also found to be more abundant in pummelo orchard with *A. pintoi* ground cover than from without cover.

These evidences of higher beneficial arthropods population density for 12-month observation period in pummelo orchard with *A. pintoi* cover crop is a proof of its efficacy of attracting beneficial arthropods in pummelo orchard, hence, a good intercrop to increase biodiversity and increase biological control activities in the orchard.

Similar result was also observed by Sabado et al (2006) of the possibility of growing cabbage even without pest management activities during the wet season in cabbage-growing areas of Mt. Malindag, Misamis Occidental during the wet season for as

long as the farm has a vast array of diverse plant covers that will serve as refuge and food source of beneficial arthropods of cabbage pests.

The practice of cover cropping from a monoculture system can provide continuous availability of habitat or refuge to beneficial arthropods and supplementary food sources such as nectar and pollen which are essential food for many hymenopterous parasitoids [1, 4, 10].

Table 1. Average population of common beneficial arthropods for 12-month observation period in pummelo orchard of USeP under with and without *Arachis pintoi* cover crop

TREATMENTS	Microhymenoptera	Macrohymenoptera	Spiders	Tachinidae	Carabidae
With *Arachis pintoi*	37.83[a]	32.65[a]	21.93[a]	33.97[a]	7.08[a]
Without *Arachis pintoi*	5.33[b]	12.99[b]	15.44[b]	12.25[b]	0.75[b]
T-test Value	5.92**	2.43*	2.84**	3.68**	3.38**
Significance value	0.00	0.024	0.009	0.001	0.006

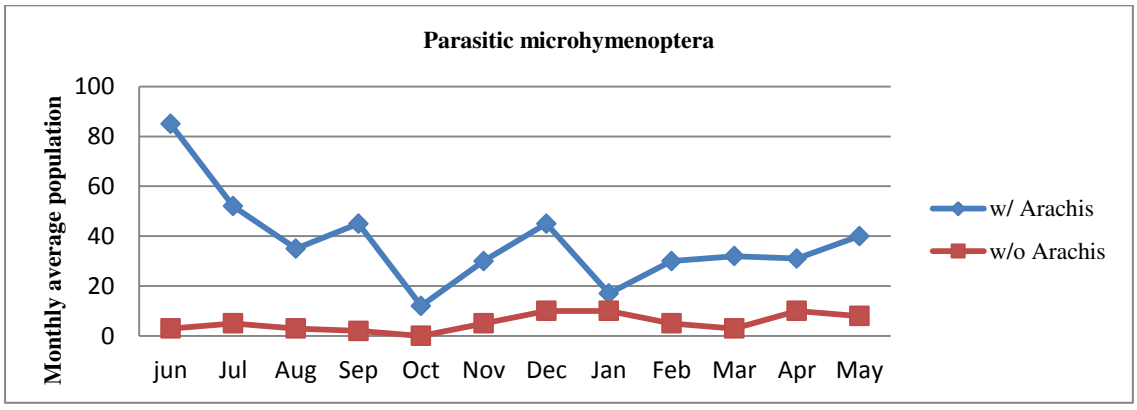

Figure 1. Monthly average population of parasitic microhyenoptera in pummelo orchard in with and without *Arachis pintoi* cover crop

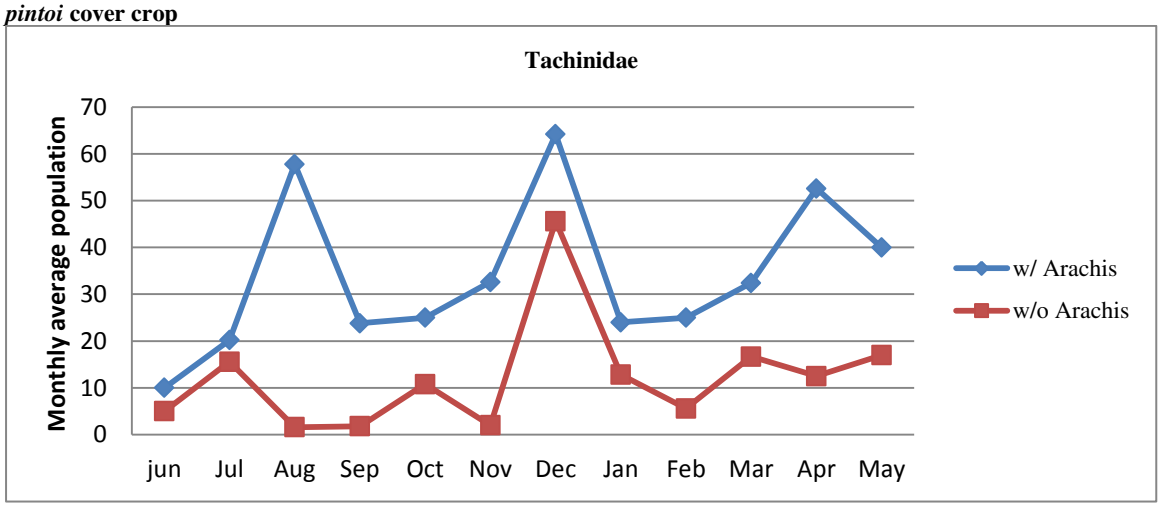

Figure 2. Monthly average population of parasitic and predatory macrohymenoptera in pummelo orchard in with and without *Arachis pintoi* cover crop

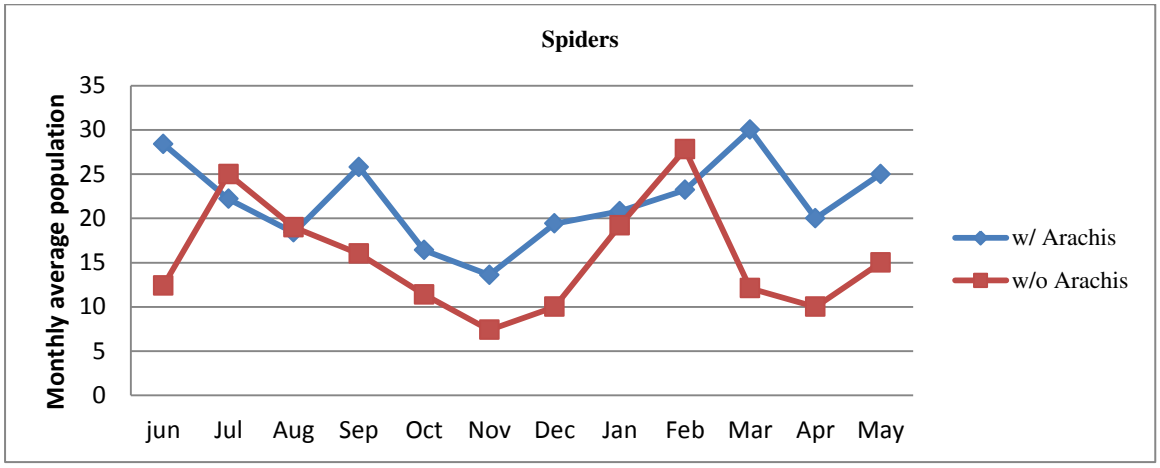

Figure 3. Monthly average population of spiders in pummelo orchard under with and without *Arachis pintoi* cover crop

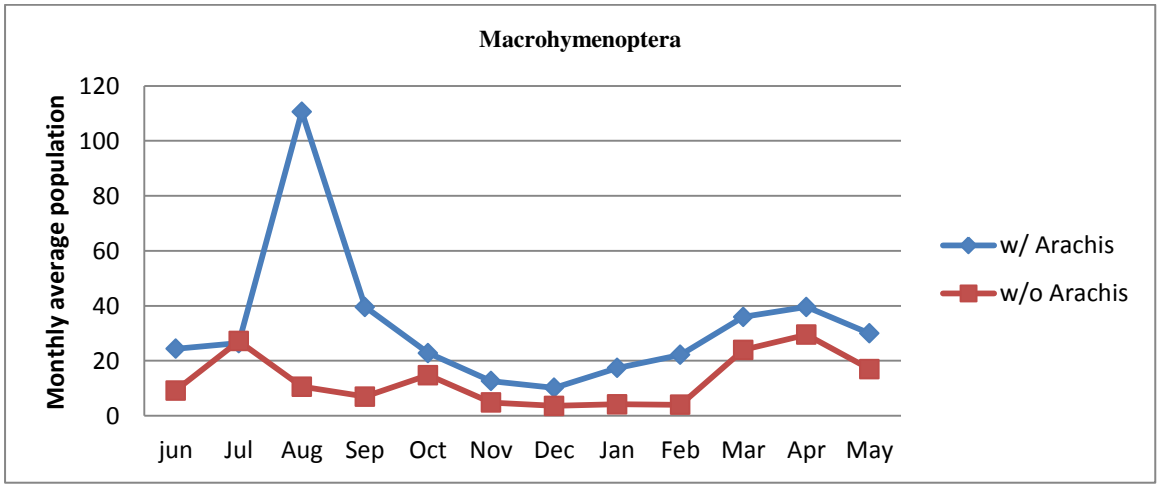

Figure 4. Monthly average population of Tachinid flies (Tachinidae) in pummelo orchard under with and without *Arachis pintoi* cover crop

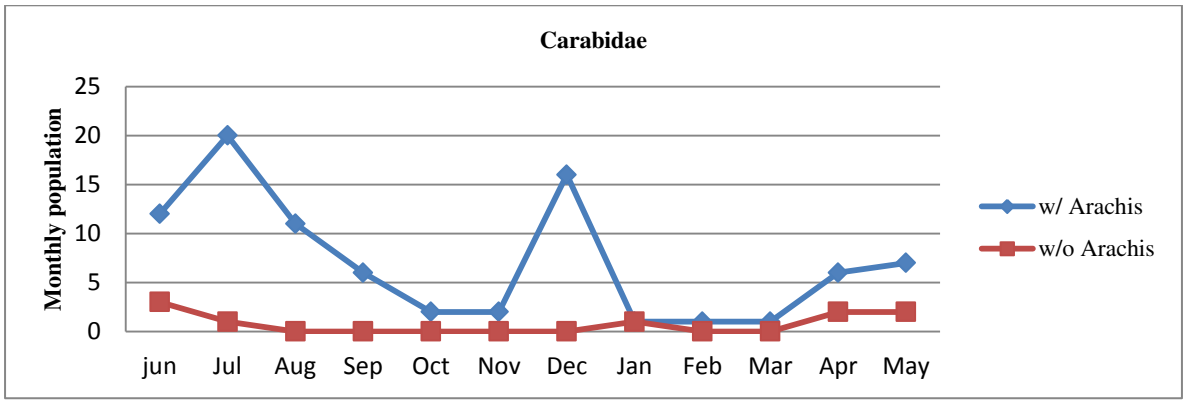

Figure 5. Monthly average population of predatory ground beetle (Carabidae) in pummelo orchard under with and without *Arachis pintoi* cover crop

4. Conclusion

Population of predators and parasitoids such as microhymenopterans, macrohymenopterans, spiders, tachinid flies (Tachinidae) and ground beetles (Carabidae) was significantly enhanced in pummelo orchard with *A. pintoi* cover crop.

Thus, based from the above findings, planting of *Arachis pintoi* as cover crop in pummelo orchard can be an effective strategy of enhancing and conserving populations of beneficial arthropods such as predators and parasitoids, hence, planting of the said cover crop is highly recommended in pummelo orchard.

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