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RESEARCH ARTICLE

ORGANIC MULCHING MATERIALS AS MEANS TO CONTROL INSECT PESTS AND WEEDS IN GREEN ONION *(ALLIUM FISTULOSUM* L.).

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Abstract

High damage was observed lately for green onion production in Marawi City condition. Majority of the damage was suspected to cause by an insect but was not identified. This study was carried with the following objectives: (1) assess the arthropods and weed population that can be found on the different types of mulching materials and (2) determine the relationships that exist between organic mulching materials, insect pests, insect damage and weeds in green onion. This was conducted in January to April 2018 during dry season at Plant Science Experimental Area, Mindanao State University Main Campus, Marawi City, Lanao del Sur, Philippines.

Results of the study showed that Lepidopterans caused most of the damage on green onion and high on grass clipping mulches. The weed population was effectively controlled by organic mulches as of evidence of weed population decline from 42 Days After Planting (DAP) to 90 DAP. The relationship of weeds, insect damage and arthropods is more evident at 90 DAP. Hymenopterans were considered to be good natural enemies of Lepidopterans, causing significantly lowered its population, thus lowering the damage. Lepidopterans population increases with increasing sedges population, hence sedges should be controlled at early stage of the crop. Hymenopterans preferred grasses as habitat.

Overall, organic mulches control the population of weeds and become the habitat of arthropods in the soil.

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Introduction:-

Many of production activities nowadays are considered detrimental to plants and soil. This damage the ecology of the soil, reducing its ability to absorb and retain water, store and cycle nutrients, and maintain good soil structure. As a result, erosion and leaching of nutrients are more likely to occur (Feezer, 2014). To overcome this problems, the concept of organic farming came into conception where using of mulching materials is part of many suggested ways.

Mulching is an agricultural and horticultural technique in which the use of organic residues is involved. The word mulch has been probably derived from the German word "*molsch*" means soft to decay (Bhardwaj, 2013). Mulching does not perform instant miracles, but it encourages better plant growth and development. And for more than a thousand years now, mulching has been used in several parts of the world to evade drought and increase crop yield (Inusah et al, 2013). Mulches can be derived from either organic or inorganic materials. Aside from that mulching can also control weeds which competes the crop in many aspects. In using this technique arthropods are usually associated.

Arthropods are members of the Phylum Arthropoda which comes from two Greek words arthron and podos, where arthron means "joint", and podos means "foot", which together mean "jointed feet (http://razzabali.webs.com/Arthropoda-General). Arthropods, especially insects, are of enormous economic importance and affect all aspects of human life. They compete with humans for food of every kind, play a key role in the pollination of certain crops, and cause billions of dollars of damage to crops, before and after harvest. They are by far the most important herbivores in all terrestrial ecosystems and are a valuable food source as well. Virtually every kind of plant is eaten by one or more species of insect and diseases spread by insects cause enormous financial damage each year and strike every kind of domesticated animal and plant, as well as human beings (http://www.mhhe.com/biosci/genbio).

Infestation of insect pests had always been associated in growing onion. In Marawi condition, it was lately observed that damage was high in green onion production sites. Due to environmental condition such as drought and excess moisture (Nault, 2011), this damage might occur. However, this environmental condition can also trigger the infestation of insect pests and/or weeds.

In search of an environmentally, pocket friendly and sustainable technology this study aims to discover the potential use of locally available mulching materials as means to control insect pests and weeds in green onion.

Objectives:-

1. Assess the arthropods and weed population that can be found on the different types of mulching materials, and
2. Determine the relationships that exist between organic mulching materials, insect pests, insect damage and weeds in green onion.

Methodology:-

Site Description

The field experiment was conducted at the Department of Plant Science Experimental Area, College of Agriculture, Mindanao State University Main Campus, Marawi City, Lanao del Sur, Philippines during dry season of January to May 2018.

Experimental Design

The experiment was laid out following Randomized Complete Block Design (RCBD) with six treatments and three replications. A total area of 8m x 6.69 m (53.52m^2) was divided into three equal blocks representing the replication. Each block was divided into six treatments. The distance between treatments were 50 cm while the distance between blocks were 1 m.

Treatment Used

1. T_1–Control (no application of Mulching Materials)
2. T_2– Wild Sunflower
3. T_3– Grass Clippings
4. T_4– Rice Hull
5. T_5– Plastic Film
6. T_6– Kakawati leaves

Preparation and Application of Mulching Materials

The mulching materials was gathered and prepared prior to planting. Mulching materials like kakawati leaves and wild sunflower were chopped and shredded into pieces. After sowing, organic mulching materials were then applied according to its treatment with a thickness of 5 cm.

Cultural Management and Practices

Land Preparation
The area was prepared by removing weeds. The soil was loosen using farm tools followed by lay-outing.

Preparation of Materials
Preparation of planting material was needed prior to planting. Trim the top portion of the leaves to reduce transpiration and increase the plant survival.

Planting
Planting was done with the distance of 15cm x15cm between rows and hills at 5cm deep. Irrigate the field before and after the planting.

Fertilizer
A handful of vermicompost was applied at basal to each treatment before planting the green onion seedling.

Irrigation
Sufficient moisture was ensured throughout the growing season.

Weeding Management
No weeding was done.

Pest and Disease management
There was no application of pesticide was done.

Harvesting
The plants were harvest at 90 DAP. It was done by uprooting the plants.

Results And Discussion:-

Collection and Classification of Arthropods
The arthropods were collected in the upper portion of the mulching materials not necessary included the lower portion. Classes Arachnida and Insecta were the common arthropods associated with Green onion during dry season in Marawi City. Class Arachnida is represented by Araneida family while different orders of Insecta were identified: Hemiptera (Brown Planthoppers), Coleptera (Leaf Beetle), Lepidoptera (Semi looper and Cutworm), Hymenoptera (Red Ants and Black Ants) and Orthoptera (Grasshopper). There are more collected insects and arthropods in organic mulches and it can affect wide range of different insects (Gill et. al, 2011).

Table 1:-Arthropods associated with green onion as affected by the different applicationof mulching materials.

Class/Order	Family/Subfamily	Common Name
A.Arachnida	Araneidae	Unidentified Spiders
B.Insecta		
1. Hemiptera	Delphacedae	Brown Planthoppers (*Nilaparvata lugens)*
2. Coleoptera	Chrysomelidae: Galerucin	Leaf beetle *(Aulacophora flavomarginata*)
3. Lepidoptera	Noctuidae	Semi looper (*Argyro grammasignata)* Cutworm (*Agrotisipsilon)*
4. Hymenoptera	Myrmicinae Formicidae	Red ant(*Solenopsis)* Black ant (*Lasius niger)*
5. Orthoptera	Acrididae	Green grasshopper (*Omocestus viridulas)*

Arthropods Population

Arachnida

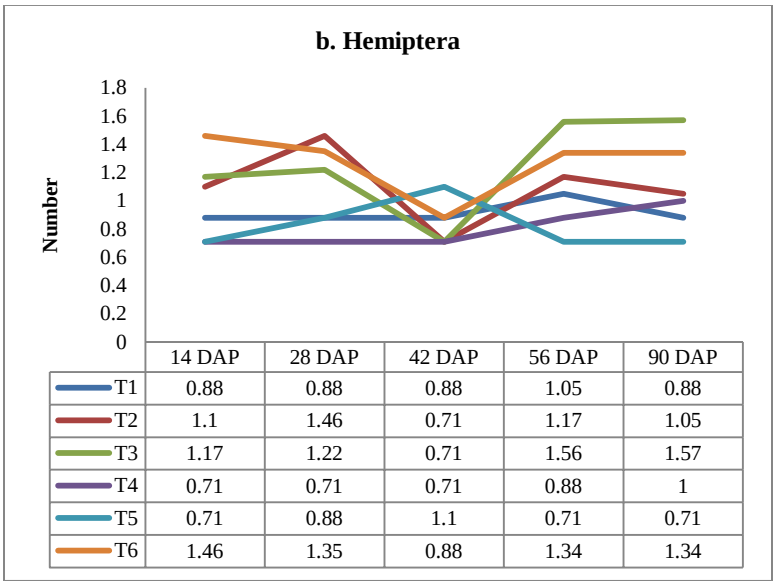
Arachnida population was not affected by the organic and plastic mulches until 90 days (Fig 1a). The highest number of Arachida was consistently higher in T2 (wild sunflower) and lowest in T5 (plastic film). In the 90th day, significant number of arthropods was recorded. Wild sunflower, no mulch application, grass clippings and kakawate leaves were significant while rice hull and plastic film were least significantly used for habitat of Arachnida.

Spider upon constant exposure to dry air and sunlight can be fatal thus, it was observed from the trend that T1 (control), T4 (rice hull) and T5 (plastic mulch) lower their population from 56 to 90 DAP due to mulching materials. Increasing population was evident in wild sunflower from 56 to 90 DAP. The result might be due to much warmer soil surface of the rice hull and plastic mulch that repel the Arachnida habitat in these particular mulches.

Hemiptera

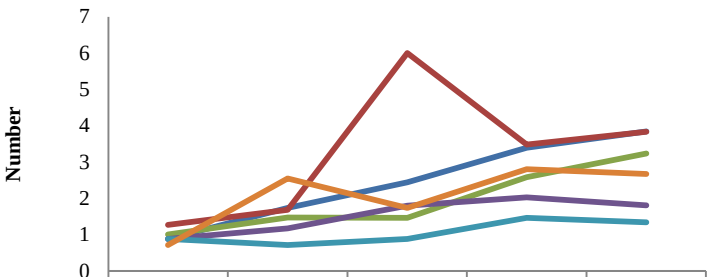
There is a fluctuation on the population of Hemiptera observed throughout the study (Fig. 1b). At 14 ND 28 DAP, T2 (wild sunflower) harbors the most number of hemipterans. At 42 DAP there was a noted decrease on their population, almost few had found in the area. T5 (plastic film) was found to be the most number of hemipterans. At 56 DAP and 90 DAP, T5 (grass clippings) harbored most of the hemipterans.

Critical stage of hemipterans is at 28 DAP and suddenly lowers its population at 42 DAP. Its gradually increased at 56 DAP and maintained its population until 90 DAP. The results suggests that population of hemipterans fluctuates with the use of mulching materials.



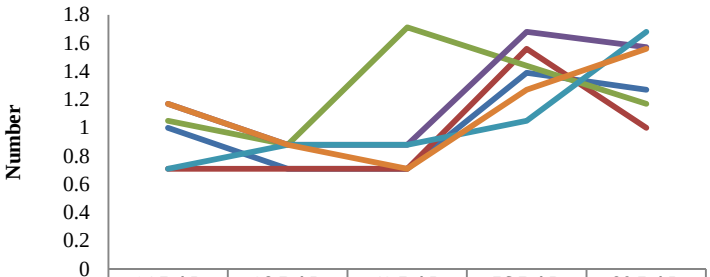
	14 DAP	28 DAP	42 DAP	56 DAP	90 DAP
T1	0.88	0.88	0.88	1.05	0.88
T2	1.1	1.46	0.71	1.17	1.05
T3	1.17	1.22	0.71	1.56	1.57
T4	0.71	0.71	0.71	0.88	1
T5	0.71	0.88	1.1	0.71	0.71
T6	1.46	1.35	0.88	1.34	1.34

c. Hymenoptera

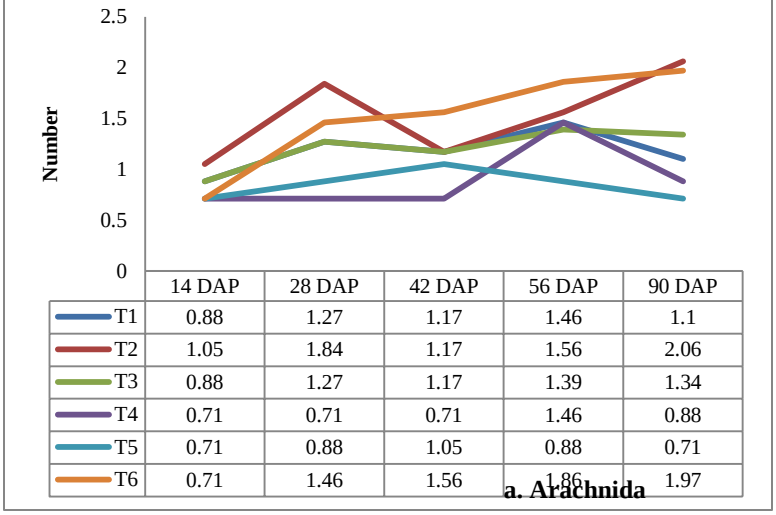


	14 DAP	28 DAP	42 DAP	56 DAP	90 DAP
T1	0.88	1.74	2.44	3.39	3.84
T2	1.27	1.68	6	3.48	3.83
T3	1	1.47	1.46	2.58	3.23
T4	0.88	1.17	1.8	2.03	1.81
T5	0.88	0.71	0.88	1.46	1.34
T6	0.71	2.55	1.74	2.8	2.67

d. Lepidoptera



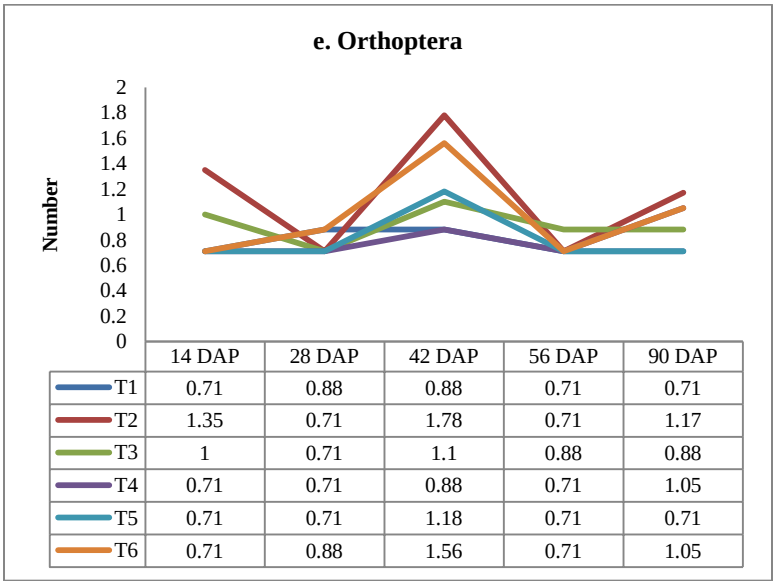
	14 DAP	28 DAP	42 DAP	56 DAP	90 DAP
T1	1	0.71	0.71	1.39	1.27
T2	0.71	0.71	0.71	1.56	1
T3	1.05	0.88	1.71	1.44	1.17
T4	1.17	0.88	0.88	1.68	1.57
T5	0.71	0.88	0.88	1.05	1.68
T6	1.17	0.88	0.71	1.27	1.56



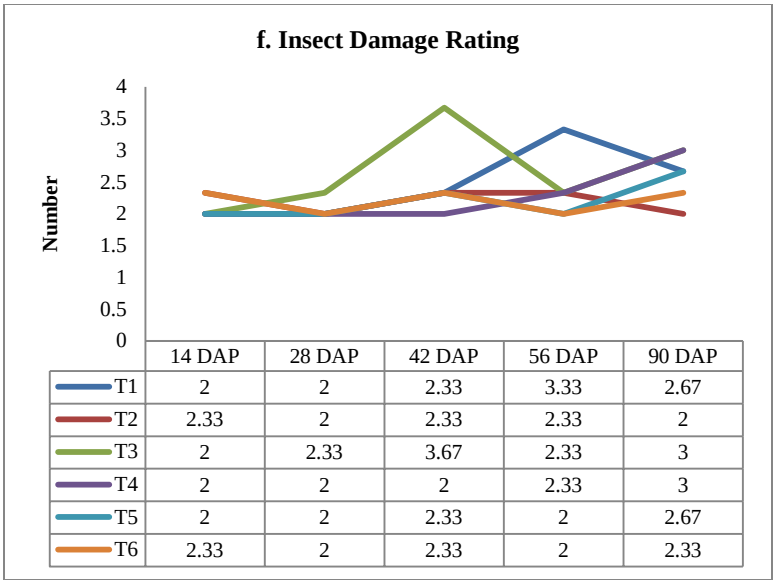
	14 DAP	28 DAP	42 DAP	56 DAP	90 DAP
T1	0.88	1.27	1.17	1.46	1.1
T2	1.05	1.84	1.17	1.56	2.06
T3	0.88	1.27	1.17	1.39	1.34
T4	0.71	0.71	0.71	1.46	0.88
T5	0.71	0.88	1.05	0.88	0.71
T6	0.71	1.46	1.56	1.86	1.97

a. Arachnida

e. Orthoptera



	14 DAP	28 DAP	42 DAP	56 DAP	90 DAP
T1	0.71	0.88	0.88	0.71	0.71
T2	1.35	0.71	1.78	0.71	1.17
T3	1	0.71	1.1	0.88	0.88
T4	0.71	0.71	0.88	0.71	1.05
T5	0.71	0.71	1.18	0.71	0.71
T6	0.71	0.88	1.56	0.71	1.05



	14 DAP	28 DAP	42 DAP	56 DAP	90 DAP
T1	2	2	2.33	3.33	2.67
T2	2.33	2	2.33	2.33	2
T3	2	2.33	3.67	2.33	3
T4	2	2	2	2.33	3
T5	2	2	2.33	2	2.67
T6	2.33	2	2.33	2	2.33

Fig 1:-Insect pests associated with Green Onion as applied with different organic mulching materials and plastic mulch. (a) Arachnida, (b) hemiptera, (c) hymenoptera, (d) Lepidoptera and (e) Orthoptera, (f) insect damage rating

Lepidoptera

The Lepidopteran population also shows fluctuation in their population. At 14, 28 and 42 DAP, T3 (grass clippings) had the most number of Lepidopterans. However, during 52 and 90 DAP, T4 (rice hull) attracted most of their kind.

From 42 to 56 DAP, the population of Lepidopterans lower in almost treatments. Decrease in population is more evident in T6 (Kakawati leaves). Only T5 (plastic mulch) lowers its population from 56 to 90 DAP. All organic mulches promotes lower number in 90 DAP. Moreover, mulching materials such as rice husk, grass clippings and saw dust mulch increases the occurrence of Fruit worm (*Helicoverpa zea*) in tomato (Rwezaula, et.al., 2005). This result follows the findings that brown plant hoppers are attracted to the green color where mulching colors are not green. The holes in the green onion are sign that the plant is damaged by Lepidopterans. In Central and Southern Vietnam, serious infestation by lepidopterans always occurs and the main species is Spodoptera exigua and is heavier in summer than spring.

Hymenoptera

At 14 DAP, T2 (wild sunflower) had the most number of Hymenopterans. At 28 DAP, T6 (kakawati leaves) harbored the most hemipterans. It was found significant to T1 (control), T2 (wild sunflower, T3 (grass clippings) and T4 (rice hull). At 42, 56 and 90 DAP, T2 (wild sunflower) attracted most of the hymenopterans compareble with T1 (control).

T2 (wild sunflower) harbors more ants in 42 DAP gradually lower in number in 52 and 90 DAP.

Orthoptera

For Orthopterans, most number was highest depending on the days after planting. At 14, 42 and 90 DAP, T2 (wild sunflower) was mostly harbor the insect. T1 (no mulching) and T6 (kakawati leaves) were highest in population. At 52 DAP, T3 (grass clippings) were found to be highest in number of Orthoptera.

Orthopterans population is highest in 42 DAP and gradually decreases in 56 and 90 DAP. The result further suggests that insect population of species observed did not significantly affected by the application of mulching materials.

Insect Damage Rating

The insect damage rating at 14, and 28 DAP showed light damage in all treatments. At 42, 56 and 90 DAP, moderate damage was recorded from T3 (grass clippings) while other treatment remains lightly damaged. At 90 DAP T4 (rice hull) were also moderately damaged by the insects.

Insect Damage Rating is highest in T3 (grass clippings) in 42 DAP and gradually decrease in succeeding days. Other mulching materials increases the damage rating from 56 to 90 DAP.

Weeds

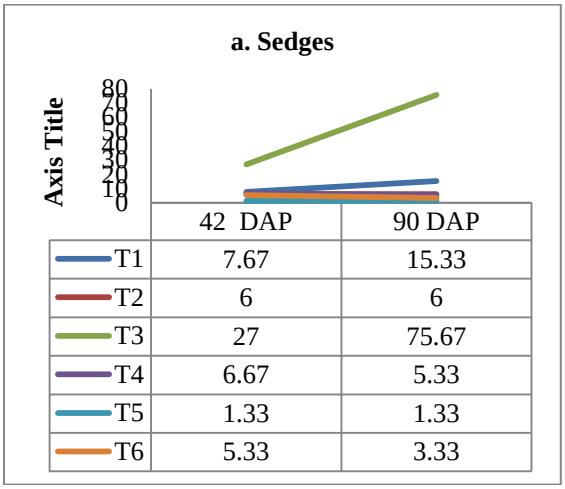
Sedges were significantly higher in T3 (grass clippings) at 42 and 90 DAP. For broadleaf, T2 (wild sunflower) was significantly higher in number at 42 DAP while T1 (control) showed the most number of broadleaf sprouted at 90 DAP. For grasses at 42 DAP, T3 (grass clippings) showed most number of grasses. However at 90 DAP, T1 (control) had the most number of grasses.

This result further suggests that mulching materials can control weeds in green onion production especially for broadleaf and sedges.

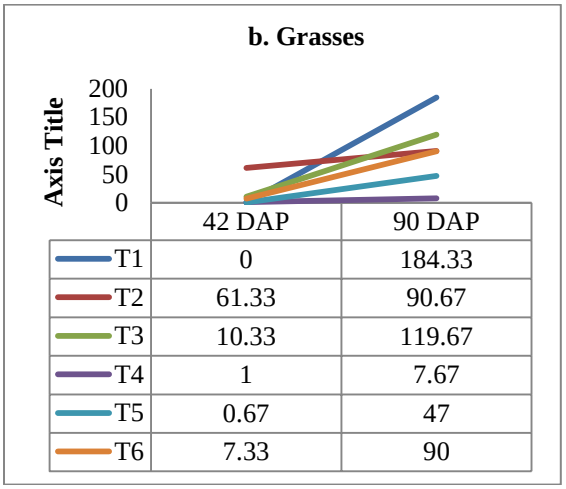
Correlation Analysis

The correlation analysis at 14 DAP showed that there is a strong correlation between Arachnida and Hymenoptera (0.8788*) and very strong correlation Orthoptera and Hymenoptera (0.9338**). The presence of Arachnida and Orthoptera may attract Hymenoptera in green onion. At 28 DAP, Arachnida and Hemiptera (0.9074*) had strong correlation which means the presence of Arachnida may be related to the Hemiptera. At 42 DAP, Lepidoptera causes damaged to the green onion having very strong correlation (0.9227**). Lepidopterans also complimented to the presence of sedges (0.9215**). This also supported that the presence of sedges may increase insect damage to plants. Grasses and broadleaf may also suggests no competition (0.9229**). At 90 DAP, Hymenopterans were used as natural enemies against Lepidopterans (-0.8904*). Lepidopterans were known to cause damage to the green onion. Still, sedges population attracted Lepidopterans (0.8126*) while grasses become the best habitat for hymenopterans (0.9070*). At 90 DAP, the presence of Arachinda threatened Lepidopterans because of the tendency that spiders eat the insects that feed on plants and vegetables (Oder, 2013).

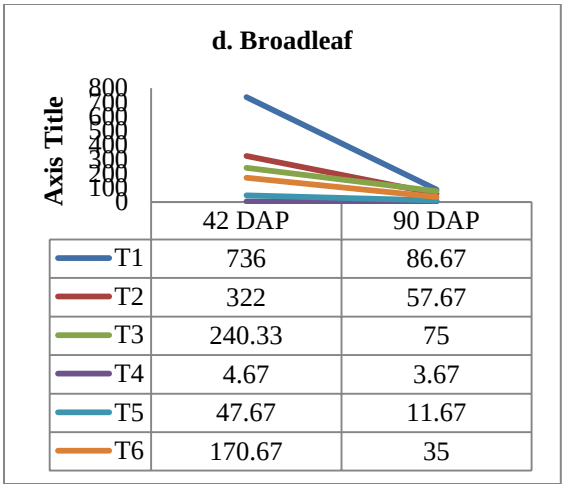
This study reveals further the relationship among insect pests, weeds and damage on green onion. Grasses harbored hymnopterans which later control the Lepidopterans. Lepidopterans were ccontributed to heavy damage in green onion.



	42 DAP	90 DAP
T1	7.67	15.33
T2	6	6
T3	27	75.67
T4	6.67	5.33
T5	1.33	1.33
T6	5.33	3.33



	42 DAP	90 DAP
T1	0	184.33
T2	61.33	90.67
T3	10.33	119.67
T4	1	7.67
T5	0.67	47
T6	7.33	90



	42 DAP	90 DAP
T1	736	86.67
T2	322	57.67
T3	240.33	75
T4	4.67	3.67
T5	47.67	11.67
T6	170.67	35

Fig 2:-Weeds population in different organic and plastic mulches; a) sedges, b) grasses, c) broadleaf

Conclusion:-

Lepidopterans caused most of the damage on green onion and high on grass clipping mulches. The weeds population was effectively controlled by organic mulches as evidence of weed population decline from 42 DAP to 90 DAP. The relationship of weeds, insect damage and arthropods is more evident at 90 DAP. Hymenopterans were considered to be good natural enemies of Lepidopterans, causing significantly lowered its population, thus lowering the damage. Lepidopteran population increases with increasing sedges population, hence sedges should be controlled at early stage of the crop. Hymenopterans preferred grasses as habitat.

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