

## EFFECT OF ORGANIC PRODUCTS ON PULSE BEETLE, *CALLOSOBRUCHUS MACULATUS* FAB. (COLEOPTERA: CHRYSOMELIDAE) INFESTING COWPEA

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**Abstract:** Pulses are mainly damaged by bruchids in storage. To manage pulse beetles/bruchids organically, the research work on ‘Effect of different organic products on pulse beetle, *Callosobruchus maculatus* Fab. (Coleoptera: Chrysomelidae) infesting cowpea’ was carried out in the laboratory at the Department of Agricultural Entomology, College of Agriculture, Dapoli at room temperature  $25 \pm 30^\circ\text{C}$  and Relative humidity  $85 \pm 2$  per cent during the year 2019-20. Eight different organic products like Agniastra, Jeevamrit, Ghanajeevamrit, Brahmastra, Neemastra, Mixed-leaf extract, Dashparni extract and Chilli-Garlic extract at 3% concentration were tested against pulse beetle, *Callosobruchus maculatus* Fab. Homogenous fifth susceptible generation of pulse beetle, *C. maculatus* was taken as test insect and cowpea as a test pulse. During developmental studies, observations on efficacy of various parameters like fecundity, developmental period, adult emergence, adult longevity, weight loss, germination percentage etc. were recorded. Mean oviposition period of *C. maculatus* on cowpea ranged from 4 to 6.67 days, highest fecundity was observed in untreated control i.e. 679.67 and lowest in Dashparni extract i.e. 514.33 and same results observed in adult emergence i.e. 611.33 and 403.67. Due to different organic products, development period ranged from 22.67-27.00 days, adult longevity in female was ranging between 8.67 to 11.33 days whereas in male, it ranged from 7.00 to 9.67 days. Mean per cent weight loss ranged from 8.79 to 9.98% in cowpea. Mean germination percentage was highest in Jeevamrit and Ghanajeevamrit amongst all different pulses.

**Keywords:** Pulse beetle, Cowpea, *Callosobruchus maculatus*, Chilli-garlic extract

### INTRODUCTION

Pulses are the major source of protein for billions of people all over the world. Pulses belong to legume family Fabaceae (plants that grow in pods), under the sub-family Papilionaceae. Pulses are not only a lucrative source of protein, but they are also efficient adjuncts to a primarily cereal-based diet, increasing the biological importance of protein consumed. In a largely vegetarian country like India, pulses play an important role in human nutrition. They contain 20 to 30 per cent of protein which is almost three folds higher than cereal crops (Ahmed *et al.*, 2016) and carbohydrate content of the pulse is 60–65 per cent, of which starch is significantly a large fraction.

Among these pulses, cowpea, *Vigna unguiculata* (L.) assumes greater importance and thus grown as vegetable, fodder and also used for seed purpose. The choice of cowpea as vegetable can be indebted due to its nutrient content, high palatability and negligible concentration of toxic metabolites. It is rich source of proteins (22-24%), iron (0.005%), calcium (0.08-0.11%) and essential amino acids.

In storage, these pulses are likely to be attacked by number of insect pests. In India, there are about 200 species of insect pests that cause damage to stored grains and grain products. One of the major insect pests in stored pulses is pulse beetle/bruchid. Bruchids have more than 1700 species of 62 genera worldwide (Romero and Johnson, 2004). The growth and development of pulse beetle, *Callosobruchus*

*maculatus* Fab. depends on the nutritional value of the seeds. Infestation of bruchids mainly begins in the field, where the beetles lay eggs on mature pods and through these pods, infestation enters storage. The main pest population builds up during the storage, as the insect feeds inside the grain and emerges as an adult and causes secondary infestation ultimately resulting in heavy losses. The infested pulses become unhygienic, as it increases free fatty acids and the oxidative rancidity along with reduction in weight and market value. (Raja and William, 2008; Patel, 2011; Sagheer *et al.*, 2013; V. Sarda *et al.*, 2018). The larvae bore into the pulse grains and eat endosperms which not only reduces viability for replanting or sprout production but also makes it unsuitable for human consumption. Bruchids damage the seeds qualitatively by contaminating the grains with excrement and fragments furthermore quantitatively by causing grain losses by consumption.

Thus considering the need and scope, aforementioned study was commenced under laboratory conditions to evaluate effect of organically treated pulses on pulse beetle, *Callosobruchus maculatus* Fab. infesting cowpea in year 2019-20.

### MATERIALS AND METHODS

The experiment was undertaken in the laboratory of Department of Agricultural Entomology, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth,

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Dapoli. Dist. Ratnagiri (Maharashtra) during 2019-20 at  $25 \pm 3^{\circ}\text{C}$  room temperature and  $85 \pm 2$  per cent relative humidity.

The materials required were working table, plastic vials, muslin cloth, test tubes, needles, forceps, plastic rearing containers, circular plastic box, glass rearing containers, hand lens, micro pipette, compound microscope, cotton, slides, trays, glass vials, rubber bands, grains of cowpea, *C. maculatus* culture, olfactometer, beakers, labels, etc.

#### **Rearing of homogenous insect culture:-**

The initial nucleus culture of infested grains of cowpea by bruchids was obtained from Regional Agricultural Research Station, Karjat and kept in glass jar. The taxonomic key given by Haines (1988), Khare (1993), Bandaara and Saxena (1995) was used for identification and isolation of desired species of pulse beetle i.e. *Callosobruchus maculatus* Fab. Healthy and uninfested seeds of cowpea were procured from local market and kept in jars. Twenty five adults isolated from original culture were released into glass jar having healthy grains. A piece of muslin cloth was placed firmly with rubber band on mouth of glass jar to prevent escape of adults. The newly emerged adults were transferred into similar sized jars containing uninfested and healthy cowpea in order to maintain the culture of test insect throughout the study. The freshly emerged adults of uniform age of homogenous fifth susceptible generation were used for further studies.

#### **Test material:-**

Leaves of different plants were collected from forest and plantations, nearby to Regional Agricultural Research Station, Karjat and various animal based products were also collected from locality itself. The standard procedures for preparation of different organic formulations are as below:

#### **Agniastra:-**

Agniastra is a botanical formulation prepared using neem leaves, chilli fruits, garlic and cow urine. In this, half kg of green chilli and garlic and 5 kg of fresh neem leaves were taken and crushed to make a fine paste. 20 liters of indigenous cow urine was added to crushed material and mixed thoroughly. The content was boiled with intermittent stirring with wooden stick for about 20 minutes after which it was cooled 48 hours and filtered with fine cotton cloth.

#### **Jeevamrit:-**

In a plastic drum of 250 liters capacity, 10 kg of fresh indigenous cow dung, 10 liters of indigenous cow urine, 2 kg of jaggary, 2 kg of pulse flour (Chickpea flour) and 150 g of soil under tree cover was added in 200 liters of water and mixed thoroughly. Drum was kept in shade covering it with gunny bag or cotton cloth or plastic mosquito net. Mixture was stirred for 5-10 minutes twice in a day (morning and evening) with wooden stick. Jeevamrit was ready for application at 9th day and could be applied upto 12th day from its preparation.

#### **Ghanjeevamrit:-**

100 kg of indigenous cow dung air dried for 4-5 days, 1 kg jaggery, 1 kg pulse flour (Chickpea flour) and 3 liters of indigenous cow urine were added together. Later, 250 gm of soil under tree cover was added to that mixture. After adding all this material, cakes were prepared out of it and stored. After 10 days of its preparation, it could be applied.

#### **Brahmastra:-**

It was a cow urine and botanicals-based formulation. 3 kg of fresh neem leaves and 2 kg of karanj (*Pongamia pinnata*) leaves were crushed into fine pieces. 2 kg of custard apple leaves and 2 kg of datura leaves were crushed and mixed in 10 liters of indigenous cow urine. Later, that mixture was stirred for about 20-25 minutes and cooled for 48 hours. The content was filtered with fine cotton cloth.

#### **Neemastra:-**

Neemastra is a neem and cow urine based liquid formulation. 5 kg of fresh neem leaves were crushed in to small pieces. Crushed leaves were mixed in 100 liters of water in a plastic drum. 5 liters of indigenous cow urine and 1kg of indigenous cow dung were mixed thoroughly with the help of a wooden stick for 2-3 minutes. Mouth of drum was covered with a fine cotton cloth and incubated for 48 hours. Content was stirred thrice a day for 2-3 minutes. After 48 hours, content was filtered with a fine mesh or cloth.

#### **Mixed Leaf extract (decoction):-**

It is also a cow urine and botanicals based formulation prepared by using the leaves of neem, custard apple, papaya, pomegranate and guava trees. 3kg of neem leaves and 2 kg of leaves each of custard apple, pomegranate, papaya and guava were crushed into fine pieces. All above crushed leaves were mixed in 10 liters of indigenous cow urine. Mixture was boiled till the volume becomes half and cooled for 24 hours. Content was filtered with fine cotton cloth and filled in bottles.

#### **Dashparni extract:-**

5 kg neem leaves and 2 kg leaves of Papaya (*Carica papaya*), Mango (*Mangifera indica*), Karanj (*Pongamia pinnata*), Castor (*Ricinus communis*), Dhatura (*Datura* spp.), Guava (*Psidium guajava*), Kaner (*Thevetia nerifolia*), bitter gourd (*Momordica charantia*), Marigold (*Tagetes* spp.) and Tulsi (*Occimum sanctum*) were taken and crushed to fine pieces. 10 liters of indigenous cow urine, 10 kg indigenous cow dung, 500 gram turmeric powder, 500 gram garlic paste, 500 grams ginger paste, 1kg tobacco leaf powder, 1 kg hot chilli paste were mixed together. All above ingredients were mixed well in 200 liters water drum in shade. Mixture was shaken thrice a day with the help of a wooden rod and fermented for 30-40 days. Later, content was filtered with fine cotton cloth and stored in the containers which could be used for almost 6 months.

#### **Chill-garlic extract:-**

It is a chilli and garlic based formulation with cow urine, neem and besharam (*Ipomoea carnea*) leaves. Paste of 500 gram of hot chilli and garlic bulbs was

made. 5 kg of neem and 1kg of besharam leaves were crushed into fine pieces which were later mixed with 10 liters of indigenous cow urine. Mixture was boiled till the volume becomes half and cools the mixture for 24 hours. The content was filtered with fine cotton cloth and filled in the bottles.

Thus organic formulations were formulated by following standard procedure and later used for seed treatment of pulse. Treated pulse grains were shade dried and later used for the experiment. The different treatments used as test material are as follows.

Sr. No.	Treatment	Name of Treatments	Conc. (%)
1.	T <sub>1</sub>	Agniastra	3
2.	T <sub>2</sub>	Jeevamrit	3
3.	T <sub>3</sub>	Ghanajeevamrit	3
4.	T <sub>4</sub>	Brahmastra	3
5.	T <sub>5</sub>	Neemastra	3
6.	T <sub>6</sub>	Mixed leaf extract	3
7.	T <sub>7</sub>	Dashparni extract	3
8.	T <sub>8</sub>	Chilli-Garlic extract	3
9.	T <sub>9</sub>	Untreated control	-

## METHODS OF TREATMENTS

Healthy, uninfested cowpea was procured from the local market of Dapoli. The moisture content of those grains was less than 10-12 per cent. The required quantity of test formulations of Agniastra, Jeevamrit, Ghanajeevamrit, Neemastra, Mixed leaf extract, Dashparni extract, Chilli-Garlic extract @ 3 per cent were mixed with 100 g healthy and conditioned pulse grains, separately. These treated pulses were shade dried for reducing the moisture. The treated grains along with control (untreated) seeds were stored and considered as a grain lot for carrying out further studies.

The experiment was laid out in Completely Randomised Design having nine treatments and three replications. Five pairs of adults were released per replication per treatment. The observations on efficacy of organic products on developmental parameters like fecundity, developmental period, adult emergence, adult longevity, weight loss, germination percentage etc. were recorded.

## RESULTS AND DISCUSSION

### Effect of organic products on mean oviposition period of *C. maculatus* in cowpea:-

In cowpea, from Table 1 and Figure 1 it is clearly indicated that, all the treatments were significantly superior over untreated control (T<sub>9</sub>) having maximum oviposition period of 6.67 days. Among the treatments, treatment T<sub>7</sub>, Dashparni extract was found significantly superior over all other treatments with minimum oviposition period of 4 days. This treatment T<sub>7</sub> was followed by treatment T<sub>4</sub>,

Brahmastra (4.33 days). Treatment T<sub>4</sub>, Brahmastra was followed by treatment T<sub>1</sub>, Agniastra and T<sub>5</sub>, Neemastra having oviposition period of 4.67 days each.

These results showed similarity with the results obtained by Kazemi *et al.* (2009), Neenu Augustine and Balikai (2019).

### Effect of organic products on mean number of eggs laid by *C. maculatus* in cowpea:-

The observations of mean number of eggs laid recorded in Table 1 and Figure 2 represented that highest fecundity under No Choice Test was observed in untreated control (T<sub>9</sub>) i.e. 679.67 and lowest in Dashparni extract (T<sub>7</sub>) 514.33. Treatment (T<sub>7</sub>) Dashparni extract was the best treatment amongst all treatments. Treatment (T<sub>3</sub>) Ghanajeevamrit and treatment (T<sub>2</sub>) Jeevamrit were at par with untreated Control (T<sub>9</sub>).

### Effect of organic products on mean number of adults emerged of *C. maculatus* in cowpea:-

The data accomplished in Table 1 and Figure 2 evaluated that, highest number of adult emergence was observed in untreated control (T<sub>9</sub>) i.e. 611.33 and lowest in Dashparni extract (T<sub>7</sub>) i.e. 403.67. Treatment T<sub>7</sub> (Dashparni extract) was the best treatment with very less number of bruchids emerged and found significantly superior over rest of the treatments. Treatment (T<sub>2</sub>) Jeevamrit was at par with Untreated Control (T<sub>9</sub>).

### Effect of organic products on mean developmental period of *C. maculatus* in cowpea:-

The data represented in Table 1 and Figure 3 showed that highest developmental period was observed in Dashparni extract (T<sub>7</sub>) i.e. 27.00 days and lowest in Untreated Control (T<sub>9</sub>) i.e. 22.67 days. Treatment T<sub>7</sub>, Dashparni extract was the best treatment amongst all treatments. As the developmental period of *C. maculatus* was prolonged by almost 4.33 days as compared to untreated pulses. Ghanajeevamrit (T<sub>3</sub>) and Jeevamrit (T<sub>2</sub>) were at par with Untreated Control (T<sub>9</sub>).

The present research findings are on same line with the findings of Patel *et al.* (2005) who revealed that the overall mean developmental period and longevity of pulse beetles on cowpea was 18.12 days and 11.37 days.

### Effect of organic products on mean female longevity of *C. maculatus* in cowpea:-

In Table 1 and Figure 4, the maximum female adult longevity was observed in untreated pulses (Control) i.e. 11.33 days and minimum in treatment T<sub>7</sub> i.e. Dashparni extract i.e. 8.67 days. Brahmastra (T<sub>4</sub>), Neemastra (T<sub>5</sub>) and Agniastra (T<sub>1</sub>) were at par with Dashparni extract (T<sub>7</sub>). Whereas, Mixed leaf extract (T<sub>6</sub>), Chilli-Garlic extract (T<sub>8</sub>), Ghanajeevamrit (T<sub>3</sub>) and Jeevamrit (T<sub>2</sub>) were found at par with Untreated Control (T<sub>9</sub>).

The present research findings showed similarity with the results obtained by Moreno *et al.* (2000).

### Effect of organic products on male longevity of *C. maculatus* in cowpea:-

In Table 1 and Figure 4, utmost male adult longevity was discerned in untreated Control i.e. 9.67 days and smidgen in Dashparni extract i.e. 7.00 days. Treatment (T7) Dashparni extract was found superior over all other treatments except Brahmastra (T4), Neemastra (T5) and Agniastra (T1) which were at par with treatment (T7) i.e. Dashparni extract. Ghanajeevamrit (T3) and Jeevamrit (T2) were less effective and found at par with Untreated Control (T9).

The results are on the same line with the results obtained by Kazemi *et al.* (2009) and Chaudasama (2015).

### Effect of organic products on mean per cent weight loss caused by *C. maculatus* in cowpea:-

The percent weight loss was observed in Table 1 and Figure 5 are arranged in ascending order as follows - Dashparni extract (T7) 8.79% < Brahmastra (T4) 8.91% < Neemastra (T5) 9.06% < Agniastra (T1) 9.22% < Mixed leaf extract (T6) 9.41% < Chilli-Garlic extract (T8) 9.56% < Ghanajeevamrit (T3) 9.70% < Jeevamrit (T2) 9.87% < Untreated Control (T9) 9.98%. Lowest percent weight loss was observed in treatment (T7) Dashparni extract 8.79%. While, highest in treatment (T9) untreated control i.e. 9.98%.

The present investigation is on line with Yadav and Tiwari (2017) who assessed animal waste products like cow dung cake powder and cow urine at a conc. of 2% against the Rice weevil, *Sitophilus oryzae*

(Linn.), on stored wheat and also with the results investigated by Osman *et al.* (2015).

### Effect of organic products on of germination percentage in cowpea:-

In Table 1 and Figure 6, highest germination percentage was observed in treatment (T2) Jeevamrit i.e. 98.00% and lowest in treatment (T8) Chilli-Garlic extract 95.00%. Treatment (T2) Jeevamrit and treatment (T3) Ghanajeevamrit were superior among all the treatments given and found at par to each other.

### CONCLUSION

From this research, it is concluded that, treatment with Dashparni extract, Agniastra, Brahmastra and Neemastra showed effective results in management of *C. maculatus*. Among them, Dashparni extract was found to be most superior against *C. maculatus* in cowpea. Jeevamrit and Ghanajeevamrit treated pulses were observed to be less effective in management of pulse beetle, but effective in improving germination percentage of the seeds. Thus, the result of this study showed that the locally available treatments gave good protection to cowpea against bruchids during storage. As being natural, eco-friendly, easily available, cost effective and easy to adopt by small and medium scale farmers, these organic products can serve as safe alternatives to synthetic insecticides and conventional harmful fumigants under storage conditions.

**Table 1.** Effect of organic products on pulse beetle, *C. maculatus* on cowpeal

[No Choice Test]

Sr. No.	Treatments	Conc.	Observations recorded (Mean)							
			Ovipositional period	No. of eggs laid	No. of adults emerged	Developmental period	Female longevity	Male longevity	Per cent weight loss	Germination percentage
1	T1-Agniastra	3%	4.67	594.33(24.40)*	494.33(22.25)*	24.67	9.67	8.00	9.22(17.67)**	95.33(77.54)**
2	T2-Jeevamrit	3%	6.00	664.67(25.80)	595.33(24.42)	23.00	11.00	9.33	9.87(18.31)	98.00(82.05)
3	T3-Ghanajeevamrit	3%	5.67	660.33(25.72)	586.67(24.24)	23.33	11.00	9.00	9.70(18.15)	97.67(81.26)
4	T4-Brahmastra	3%	4.33	548.33(23.44)	431.33(20.79)	26.00	9.00	7.33	8.91(17.37)	95.00(77.12)
5	T5-Neemastra	3%	4.67	560.00(23.68)	459.00(21.45)	25.67	9.33	7.67	9.06(17.66)	95.33(77.58)
6	T6-Mixed leaf extract	3%	5.00	615.67(24.83)	525.67(22.95)	24.00	10.33	8.33	9.41(17.68)	96.33(78.98)
7	T7-Dashparni extract	3%	4.00	514.33(22.70)	403.67(20.12)	27.00	8.67	7.00	8.79(17.25)	96.00(78.52)
8	T8-Chilli-Garlic extract	3%	5.33	642.33(25.36)	562.33(23.73)	23.67	10.67	8.33	9.56(18.01)	95.00(77.12)
9	T9-Untreated Control	-	6.67	679.67(26.09)	611.33(24.74)	22.67	11.33	9.67	9.98(18.42)	95.67(78.00)
	S.Em. ±		0.09	0.15	0.15	0.05	0.07	0.06	0.11	0.76
	C.D. (at 5%)		0.26	0.43	0.43	0.16	0.21	0.19	0.34	2.26

\*Figures in the parenthesis are square root transformed values with  $\sqrt{x + 0.5}$

\*\*Figures in the parenthesis are arc sine transformed value.

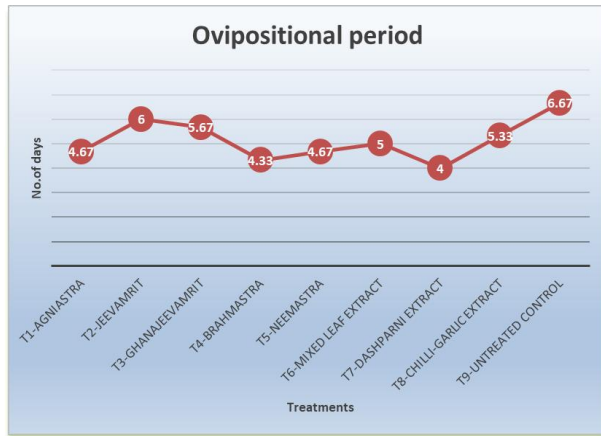


Figure No:-1

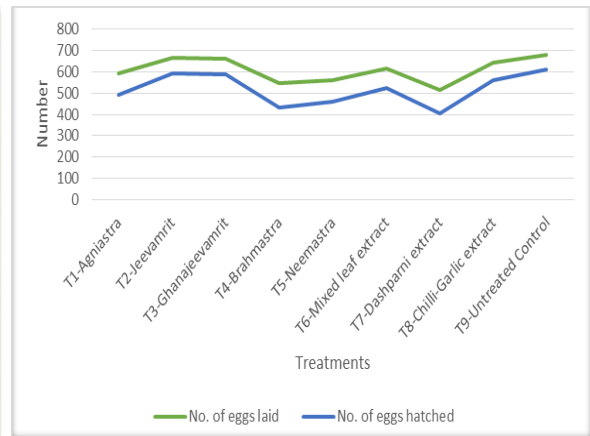


Figure No:-2

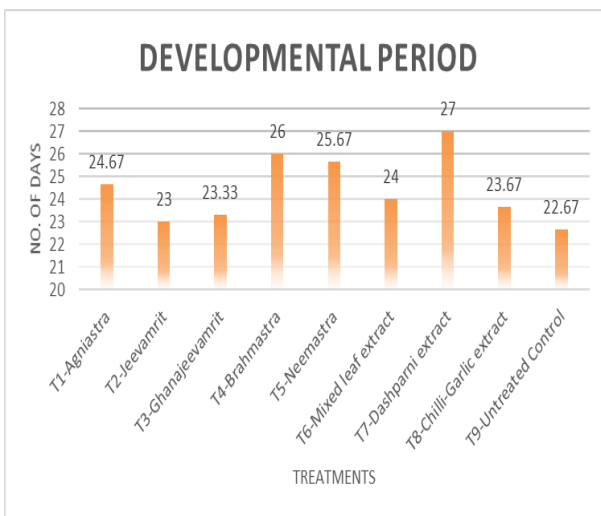


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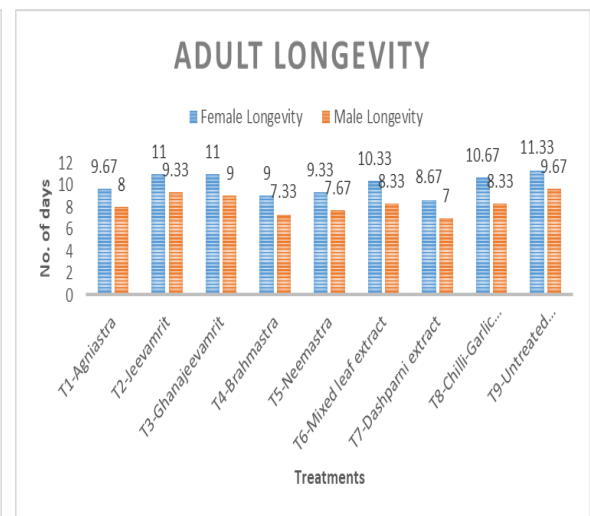


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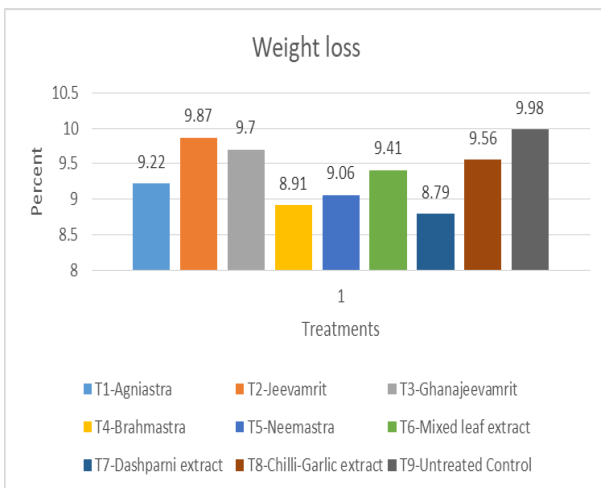


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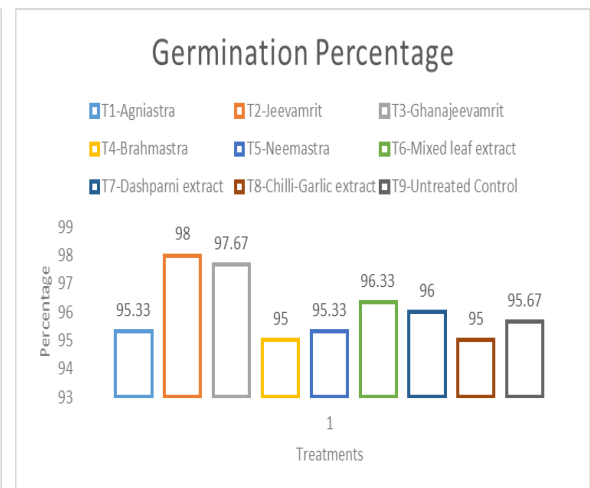


Figure No:-6

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