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Effect of organic fertilizers on major insect infestation in two cabbage cultivars

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ABSTRACT

Organic fertilizers are alterations aiming to improve soil fertility have been found to increase pest populations on cabbage plants. This study was conducted to evaluate the effects of organic fertilizers and weather factors on insect infestation with cabbage cultivars during rabi season of 2007-2008. Two cabbage varieties viz., Atlas 70 and Super tropic and organic fertilizers like control, cowdung, mustard oilcake, Vermicompost and Trichoderma were included in this study. Results revealed that the minimum no. of infested plants plot⁻¹, infested leaves plant⁻¹ and percent infested leaves plant⁻¹ were found in variety super tropic with Trichoderma applied plots on different dates of observation while the maximum no. of infested plants plot⁻¹, infested leaves plant⁻¹ and percent infested leaves plant⁻¹ were in variety super tropic and mustard oil cake applied plots. The highest number and percent (4.00 plot⁻¹) and (20.00% plot⁻¹) of infested heads were found in variety Super tropic and mustard oil cake applied plots. Highest number of healthy heads plot⁻¹ (19.67), healthy head yield (71.47 ton/ha) and total head yield (72.14 ton/ha) were recorded in variety Super tropic and Trichoderma applied plots while the lowest number of healthy heads plot⁻¹, healthy head yield and total head yield were recorded in in variety Super tropic and mustard oil cake applied plots. So application of Trichoderma with Super tropic cultivar ensures low insect infestation and better head yield.

Key Words: Cabbage, Varieties, Infestation, Trichoderma and Vermicompost

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I. Introduction

Cabbage (*Brassica oleracea* L. var. *capitata*) is one of the most popular vegetables in the world. It is also the most popular winter vegetables grown throughout Bangladesh. It is a rich source of Ca, P, Na, K, S, minerals and vitamins A, B₁, B₂, C and dietary fibre (USDA, 2014). In Bangladesh, the annual

production of cabbage is 213 thousand tons (BBS, 2012). But there are certain limiting factors for its quantitative and qualitative production. The production and yield of cabbage is greatly hampered by many insect pests. Among them, tobacco caterpillar, *Spodoptera litura* (Fab.) is the most destructive one which sometimes cause complete loss of the crop (Lee, 1986). Cabbage butterfly, diamond back moth and tobacco caterpillar are the most destructive pests causing severe yield loss to cabbage every year (Rao *et al.*, 2001). Cabbage semilooper (*Plusia aurichalcea*), grass hoppers and field crickets are also noticed to attack cabbage (Atwal, 1976). Low cabbage yields and the heavy damage caused by two lepidopteran insects, the diamondback moth (DBM) *Plutella xylostella*, and armyworm, *Prodenia (Spodoptera) litura* (Ansari *et al.*, 2012 and Stevenson, 1993). In Bangladesh, leaf eating caterpillars such as diamondback moth (DBM) and prodenia caterpillar or common cutworm (*Spodoptera litura*) are considered as the major pests of cabbage (Anonymous, 2013). *Spodoptera litura* is one of the key insect pests of cabbage, which caused more than 50 percent reduction of cabbage yield in some genotypes (Ei-Tom, 1987). After hatching, the caterpillars start feeding on the under surface of the leaves. Leaves of heavily damaged plants have many feeding holes and sometimes the leaves take a 'sieve-like' appearance. It also destroys the leaves of cabbage by making holes in the head and greatly reduces its market value. Larvae also bore into the newly formed head and reach to the newly emerging little leaf and consume it. Sometimes it causes rotting in the inner portion of cabbage. The young caterpillars along with mature caterpillars also cause greater damage if the infestation occurs at the head forming stage. As a result of feeding, the plants either fail to form compact cabbage heads or produce deformed.

Determination of population dynamics is prerequisite for the implementations of control strategy against certain insect. The indirect effects of fertilization practices acting through changes in the nutrient composition of the crop have been reported to influence plant resistance to many insect pests. Meyer (2000) argues that soil nutrient availability not only affects the amount of damage that plants receive from herbivores but the ability of plants to recover from herbivory; however, these two factors are rarely considered together. Describing the effects of soil fertility on both the degree of defoliation and compensation for herbivory for *Brassica nigra* plants damaged by *Pieris rapae* caterpillars. Some studies documenting lower abundance of several insect herbivores in low-input systems have partly attributed such reductions to the lower N content in organically farmed crops (Lampkin, 1990). Though the agro-climatic condition of Bangladesh is highly favorable for the successful cultivation of cabbage, this has not yet translated into higher yield mainly due to the attack of insect pests. The severity of the abundance/incidence of different insect pests of cabbage is greatly influenced by the prevailing climatic conditions which vary from region to region, even place to place of the country. Therefore, up to date knowledge about the abundance or incidence pattern of major insect pests and their successful management strategies. This study was undertaken to the combine effect of organic fertilizers and varieties of cabbage on the abundance and population dynamics of major insect pests infesting cabbage under field condition.

II. Materials and Methods

The field experiment was conducted at agricultural farm of Agricultural Research Station (ARS), Bangladesh Agricultural Research Institute (BARI), Pahartali, Chittagong, Bangladesh to study the influence of variety and organic manures on the profusion and population dynamics of major insect pests on cabbage during *rabi* season of 2007-2008. Two cabbage varieties *viz.*, Atlas 70 and Super tropic were included in this study. Organic manures were used as treatments like control, cowdung @ 6 kg plot⁻¹, mustard oilcake @ 750g plot⁻¹, Vermicompost @ 3 kg plot⁻¹ and Trichoderma @ 3 kg plot⁻¹. Experiment was laid out in randomized block design (RBD) with three replications. The entire field was divided into three blocks and each block was again divided into ten plots. The distance between both blocks and plots was 1.0 m. The area of each experimental plot was 9 m². Seeds of the selected cultivars were sown in the month of November and were transplanted in December. Thirty day-old cabbage seedlings were transplanted in the plot of 9 m² area with 45cm x 45cm spacing on 30 December, 2007. The chemical fertilizers *viz.*, urea, TSP and MP were applied at the rate of 280, 140 and 210 kg/ha. Fertilizer, irrigation and all other agronomic practices were carried out in the experimental field as and when needed. All inputs for example fertilizer application, irrigation, hoeing and other agronomic practices remained same for all cultivars. Recommended management practices except plant protection measures were followed for raising the crop. Harvesting of transplanted

cabbage heads were continued till February 2008. Weekly observations were taken (No. of infested plants plot⁻¹, No. of infested leaves plant⁻¹, % of infested leaves plant⁻¹, insect population count plant⁻¹, % RH and temperature) since one week of transplanting till maturity of the crop. The data obtained were analyzed by analysis of variance. The comparison of means were done using Duncan multiple random test at 0.05 level (Steel and Torrie, 1980).

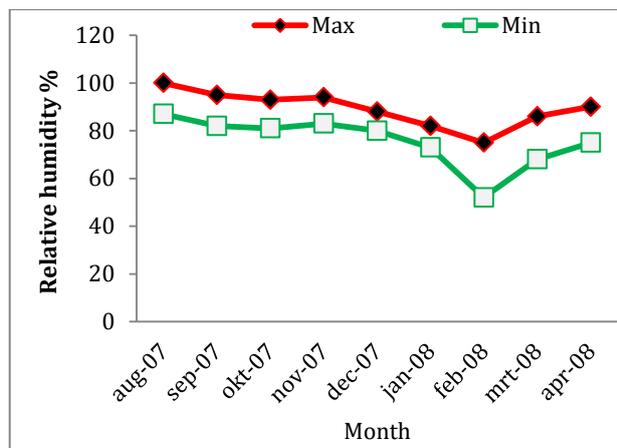


Figure 01. Monthly maximum and minimum % relative humidity at Pahartali, Chittagong 2007-2008.

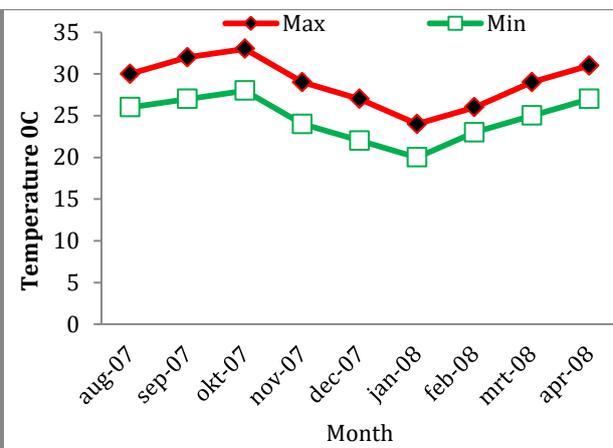


Figure 02. Monthly maximum and minimum tem. (°C) at Pahartali, Chittagong 2007-2008.

III. Results and Discussion

Influence of cabbage varieties and organic fertilizers on infested plants

The cabbage plants attracted a number of insect pests at different stages of the plant growth due to their nutritive and flourishing nature. Large number of insect were found feeding on cabbage plants and some even cut the leave, stem of less established plants. The effects of cabbage varieties and organic fertilizers on the number of infested plants plot⁻¹ varied significantly on different dates of observations (Figure 03). Among the treatments combination highest plant infestation was recorded in cultivar Super tropic with mustard oil cake and the lowest in Super tropic with Tricoderma at all observations. The optimum insect infestation was found in late February and minimum in late January. On 1st January 2008, the lowest no. of infested plants plot⁻¹ was 1.50 for the treatment combination of Super tropic and Tricoderma. The highest no. of infested plant plot⁻¹ was 3.50 for the treatment combination of Super tropic and mustard oil cake (Figure 03). On 10th January 2008, the lowest no. of infested plants plot⁻¹ was 1.00 for the treatment combination of variety Atlas-70 and vermicompost .The highest no. of infested plant plot⁻¹ was 3.50 for variety Super tropic and mustard oil cake applied plots.

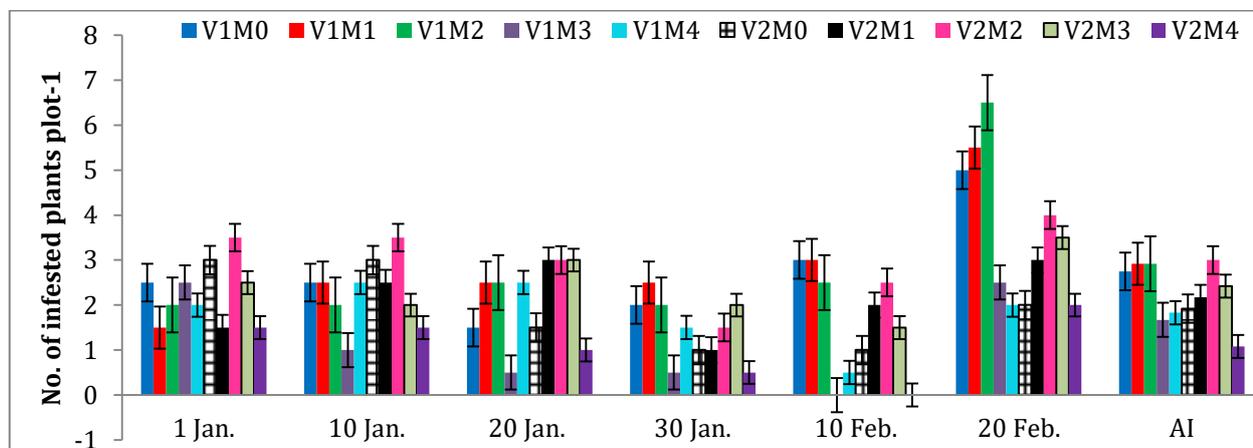


Figure 03. Combined effects of cabbage varieties and organic fertilizers on the no. of infested plants plot⁻¹ by lepidopteran larvae on different dates of observations.

V₁=var. Atlas-70; V₂ = Super tropic; M₀ = control, M₁ = cowdung, M₂ = mustard oilcake, M₃ = Vermicompost , M₄ = Trichoderma and AI= Average infestation

On 20 January 2008, the lowest no. of infested plants plot⁻¹ was 0.50 for the treatment combination of variety Atlas-70 and vermicompost. The higher no. of infested plants plot⁻¹ (3.00) was recorded in Super tropic and cowdung (Figure 03). On 30 January 2008, no significant differences were observed among different treatment combinations regarding the no. of infested plants per plot (Figure 3). On 10 February 2008, no plant was infested in treatment combinations of variety Super tropic and Tricoderma and variety Atlas-70 and vermicompost applied plots. The higher no. of infested plants/plot (3.00) was in Atlas-70 and control plots. On 20 February 2008, the lowest no. of infested plants/plot (2.00) was observed in variety Super tropic and Tricoderma and the highest was 6.50 found in Atlas-70 with mustard oil cake applied plots (Figure 03). Khan (2007) observed that the common cutworm and *Spodoptera litura* was highly susceptible to cabbage variety of Atlas-70 and the lowest in the variety Loral. Miguel and Clara (2003) observed that crops grown with organic matter generally exhibit less insect herbivores, reductions that may be attributed to a lower nitrogen content in organically farmed crops.

Combined effects of cabbage varieties and organic fertilizers on infested leaves

The no. of infested leaves plant⁻¹ was significantly varied to variety and applications of organic fertilizer are presented in Table 1. The organic fertilizer cowdung, mustard oil cake treated plots recorded the largest mean percentage leaf damage, whilst the Tricoderma and vermicompost plots recorded the least percentage leaf damage. The lowest no. of infested leaves plant⁻¹ was recorded in variety Super tropic and Tricoderma applied plots and the highest was 7.50 observed in variety Atlas-70 and control applied plots (Table 01) on 1 January 2008. On 10 January 2008 the lowest no. of infested leaves plant⁻¹ (0.50) was observed in variety Super tropic and Tricoderma and the highest in variety Atlas-70 and control plots (10.00) (Table 01). The highest no. of infested leaves plant⁻¹ (9.00) was recorded in variety Super tropic and mustard oil cake and the lowest in Super tropic and Tricoderma applied plots on 20 January 2008. On 30 January 2008, the highest no. of infested leaves plant⁻¹ (8.50) was recorded in variety Super tropic and mustard oil cake and the lowest in V₁M₃ (0.50) (Table 1). The highest no. of infested leaves plant⁻¹ (9.50) was found in variety Super tropic and mustard oil cake applied plots while the lowest no. of infested leaves plant⁻¹ (0.50) was in V₁M₄ applied plots on 10 February 2008. On 20 February 2008, the highest no. of infested leaves plant⁻¹ was recorded in variety Super tropic and mustard oil cake applied plots while the lowest no. of infested leaves plant⁻¹ (2.00) was in variety Atlas-70 and vermicompost applied plots (Table 01). Altieri and Nicholls (2003) reported that crops grown in highly fertile soil generally exhibit lower abundance of several insect herbivores, reductions that may be attributed to a lower N content in organically farmed crops. Crop losses to insects and diseases are reduced with organic farming (Merril, 1983).

Table 01. Combined effects of cabbage varieties and organic fertilizers on the no. of infested leaves plant⁻¹ by lepidopteran larvae on different dates of observations

Treatment combinations	Number of infested leaves plant ⁻¹						Average number of infested leaves/plant
	1 Jan.	10 Jan.	20 Jan.	30 Jan.	10 Feb.	20 Feb.	
V ₁ M ₀	7.50a	10.00a	7.50a	7.00a	6.50b	7.50b	7.67
V ₁ M ₁	6.00a	5.50b	4.00bc	4.00b	5.50b	2.50d	4.58
V ₁ M ₂	5.00b	6.00b	5.00b	5.00b	4.00bc	7.50b	5.42
V ₁ M ₃	3.50bc	3.00c	2.50c	0.50d	0.00d	2.00d	1.91
V ₁ M ₄	2.50c	1.50d	2.00c	2.50c	0.50d	4.50c	2.25
V ₂ M ₀	2.00c	5.00b	4.00bc	5.50b	4.00bc	5.50c	4.33
V ₂ M ₁	3.50bc	6.00b	6.00b	2.50c	6.00b	7.50b	5.25
V ₂ M ₂	4.00b	7.50b	9.00a	8.50a	9.50a	11.00a	8.25
V ₂ M ₃	2.00c	2.50c	5.00b	4.00b	3.00c	5.50c	3.67
V ₂ M ₄	1.00d	0.50d	0.50d	1.00cd	0.00d	4.00c	1.17
LSD	1.502	1.542	1.623	1.432	0.860	1.641	-
Level of sig.	**	**	**	**	**	*	-
CV (%)	5.71	4.80	3.79	4.48	2.61	6.40	-

Means within a column followed by different letters are significantly different from each other at 5% (*) and 1% (**) level of probability by DMRT.

V₁=var. Atlas-70; V₂ = Super tropic; M₀ = control, M₁ = cowdung, M₂ = mustard oilcake, M₃ = Vermicompost and M₄ = Trichoderma

Combined effects of cabbage varieties and organic fertilizers on percentage of infested leaves

For the two growing cultivars, there were significant differences in percentage plant damage among the four treatments. On 1 January 2008, the lowest percentage of infested leaves/plant (7.79%) was recorded in variety Super tropic and Tricoderma applied plots and the highest was 58.69% observed in variety Super tropic and mustard oil cake (Figure 4). On 10 January 2008, significantly the lowest percentage of infested leaves/plant (4.17%) was recorded in variety Super tropic and Tricoderma applied plots. On 20 January 2008, the lowest percentage of infested leaves/plant (3.34%) was recorded in variety Super tropic and Tricoderma applied plots and the highest was 61.61% observed in variety Super tropic and mustard oil cake. On 30 January 2008, the lowest percentage of infested leaves plant⁻¹ (4.17%) was recorded in variety Atlas-70 and vermicompost applied plots while the highest was 53.96% observed in variety Super tropic and mustard oil cake. On 10 February 2008, the highest percentage of infested leaves plant⁻¹ (61.67%) was observed in variety Super tropic and mustard oil cake applied plots while the lowest was 3.57% recorded in variety Atlas-70 and Tricoderma applied plots (Figure 4). On 20 February 2008, the lowest percentage of infested leaves plant⁻¹ (18.18%) was recorded in variety Atlas-70 and vermicompost applied plots and the highest in variety Super tropic and mustard oil cake applied plots. [Getnet and Raja \(2013\)](#) found that significant differences were observed in the growth and development of cabbage and pest infestation level between vermicompost applied and control plants. They also stated that vermicompost have significant impact on cabbage growth promotion and reduce the aphid infestation. Proponents of alternative agricultural methods contend that crop losses to insects and diseases are reduced with organic farming ([Oelhaf, 1978](#)).

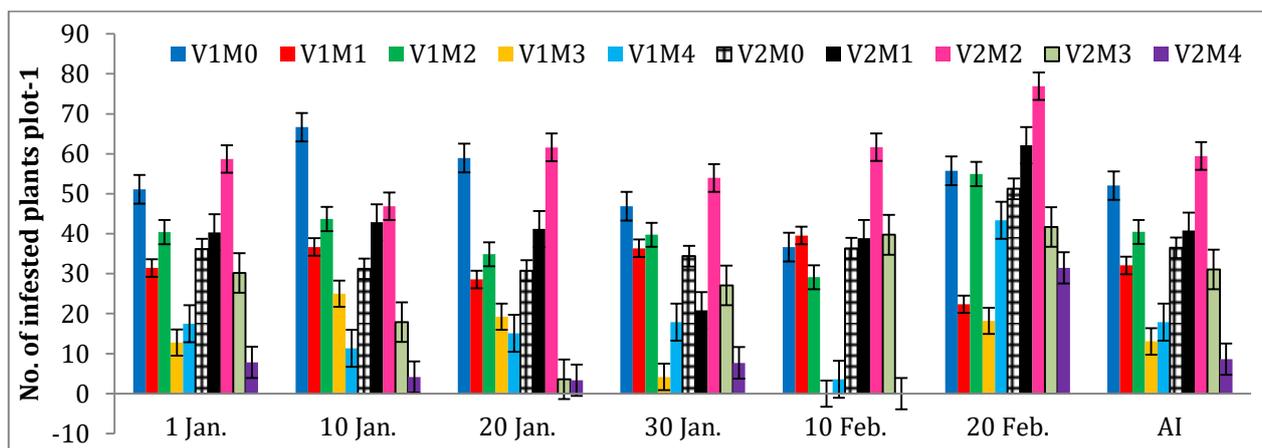


Figure 04. Combined effects of cabbage varieties and organic fertilizers on the percentage of infested leaves per plant by lepidopteran larvae on different dates of observations.

V₁=var. Atlas-70; V₂ = Super tropic; M₀ = control, M₁ = cowdung, M₂ = mustard oilcake, M₃ = Vermicompost, M₄ = Trichoderma and AI= Average infestation

Combined effects of cabbage varieties and organic fertilizers on population of *Spodoptera litura* and *Pieris brassicae* larvae

Cabbage plants attracted by of *Spodoptera litura* and *Pieris brassicae* larvae at different growth and reproductive stages. The insect affinities to succulent plants and feeding to the leaf, stem and head of cabbage. The application of nutrients to the soil aids plants to produce more broad, succulent and fresh leaves, which could serve as suitable surfaces for egg-laying by the various pests ([Jahn, 2004](#)). The maximum no. of *Spodoptera litura* and *Pieris brassicae* larvae plant⁻¹ was 1.22 and 1.32 respectively found in cultivar Supertropic with mustard oilcake. And the minimum no. of *Spodoptera litura* and *Pieris brassicae* larvae plant⁻¹ was 0.19 and 0.23 respectively in cultivar Super tropic with Tricoderma at same dated observation ([Figure 05 and 06](#)).

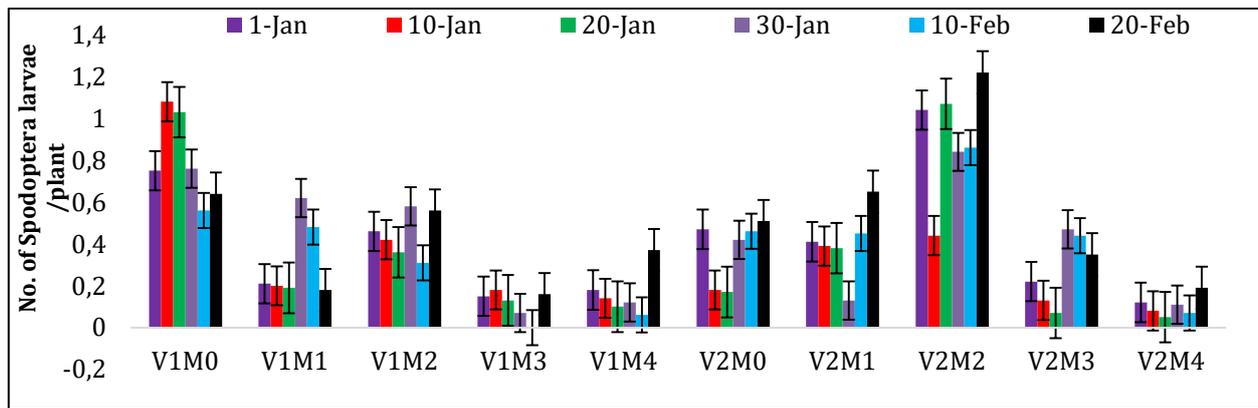


Figure 05. Population of *Spodoptera litura* on different dates of observation as influenced by cabbage varieties and organic fertilizers and organic manures

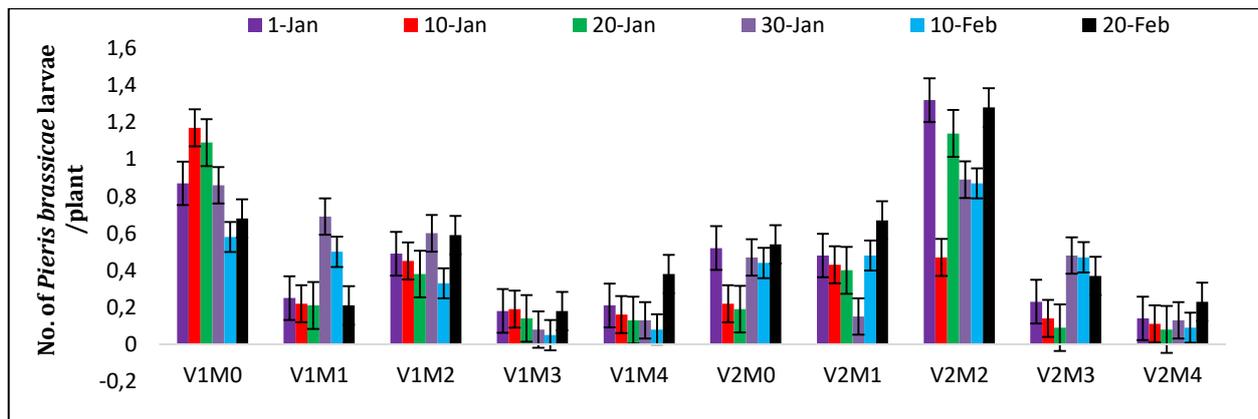


Figure 06. Population of *Pieris brassicae* on different dates of observation as influenced by cabbage varieties and organic fertilizers

V₁=var. Atlas-70; V₂ = Super tropic; M₀ = control, M₁ = cowdung, M₂ = mustard oilcake, M₃ = Vermicompost and M₄ = Trichoderma

IV. Conclusion

Cultivars of cabbage grown in trichoderma and vermicompost applied plots were found to be less infested by *Spodoptera litura* and *Pieris brassicae* regarding no. of infested plants plot⁻¹, number and percent of infested leaves plant⁻¹ on different dates of observation. Highest healthy heads (by number), healthy head yield (by weight) and total head yield were obtained from combine effect of variety Super tropic and Tricoderma as well as variety Atlas-70 and vermicompost applied. Finally it may be suggested that soil fertility management by using trichoderma and vermicompost can have several effects on plant quality, which in turn, can affect insect abundance and subsequent levels of herbivore damage.

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