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## Reduction in Phenological Parameters and Yield of *Brassica campestris* Due to Aphids in Various Insecticide Regimes

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### Abstract

The immense monetary importance of *Brassica* is due to its versatile use such as fresh consumption, edible oil, grass and green manuring. Aphid is the dreadful pest of *Brassica* that has caused significant losses to it. The present study was conducted to estimate the losses in yield. A field trial was conducted to evaluate phenological parameters having four different cultivars of *B. campestris* subjected to three different insecticide regimes by implementation of RCBD subsequent to the split plot in 2014-15 at Agricultural Farm of Bahauddin Zakariya University Multan. Population of aphids (*Brevicoryne brassicae* and *Lipaphis erysimi*) was observed haphazardly in non-sprayed and single sprayed treatments. Aphids reduced the phenological traits and yield of the Brassica plants significantly ( $P < 0.05$ ). The effect of plant variety and interaction of variety and insecticide was non-significant ( $P > 0.05$ ) there was no difference except in case of yield factor where varietal response expressed significant results irrespective of insecticide treatment which was found significant ( $P < 0.05$ ) among all the factors. It was found that single sprayed insecticide treatment was fruitful to cover up to 40 % yield loss.

**Keywords:** Aphids<sup>1</sup>; *B. campestris*<sup>2</sup>; Imidacloprid 250 SL<sup>3</sup>; phenological attributes and yield<sup>4</sup>

## Introduction

Brassicas possessed rich source of nutrition due to plenty of vitamin C, fibers solubility, multiple nutrients and anticancer properties. The inhibition of cancer cell growth and encouragement of in vitro DNA repair cells is due to a rich source of a chemical compound indole-3 carbinol in it. High level of carotenoids is present in it especially in broccoli. The most important delimiting factor to the phenological factors and yield of Brassica family is insect pests. Aphids are damaging cosmopolitan insect pest on the Brassica family (Ali et al., 2003; Ramirez et al., 2020) Aphid, *Brevicoryne brassicae*, tarnished cosmopolitan sucking pale-greyish, louse appearance feed on reproductive parts of the plant and can cause deleterious losses to oil seed crops in different seasons (Castle & Narango 2009). They reproduce parthenogenetically whole the season and remain abundant from December to March. Single female can give nativity to 26-133 nymphs and 45 generations completed approximately in year. They suck the cell sap through the inflorescence resulted low vigor and undersized plant growth. All the phenological parameters like leaves, pods and branches become paled, curled and wilted results in adversely loss to yield (Graham, 1984). In winter, Aphid, *L. erysimi* (K.) pale greenish to yellowish, become heavily colonized on crop that it can reduce the yield parameters of Brassicas bitterly. Such kind of yield losses is reported varying from 27-96% (Anwar et al., 2009). The introduction of natural enemies having varied pest searching as well as life cycle of asynchronous mode (Smitha et al., 2006, Swaminathan, 2010) but they are no in sufficient quantity to reduce the pest population pressure through threshold level. In USA, 1979, different research trial was performed on Brassica species and significantly reduction in yield and its attributes was observed (Bakhetia et al., 1979). Insecticide treatment on mustard affected the yield and its parameters as different significantly compared to untreated trial in Bangladesh (Sarwar et al., 2004). Reduction in yield parameters due to *L. erysimi* overpopulation is reported on *B. juncea* in India (Iqbal et al., 2015; Koirala, 2020) Insecticides treated plots resulted in significant increase in yield parameters such as nos. of pods/plant and yield as compared to untreated plots on late sown *Brassica spp.* in USA (Bakhetia et al 1973; Hussain et al 2014).

Previous reported work was about the aphid's attack on the photosynthetic parameters of *B. campestris* cultivars (Graham et al., 1984; Hussain et al., 2014) but there is no work reported about the aphid's attack on the yield and phenological characteristics of *B. campestris* after various pesticide treatments. So, to compete the challenge of this pest in this region this research trial was focused so that further famers can get rid to this massive attack of this pest by adopting this procedure and can get maximum benefit from it.

## Materials and Methods

### Conduction of Research Experiment:

On November 5, 2014, the study experiment was carried out at the Agricultural study Farm, Faculty of Agricultural Sciences and Technology, Bahauddin Zakariya

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University Multan, located at 30°16'33.81 N and 71°30'51.57 E, Southern Punjab, Pakistan, during the Brassica growing season. Following ha split plot experiment with three replications, the *B. campestris* cultivars that were being tested *B. campestris* A, Toria selection a, *B. campestris* PARC, and *B. campestris* Local seeded in Randomized Completely Block Design (RCBD) were manually pouring into the soil. Six rows with an adjusted row-to-row distance of 1.5 m and plant-to-plant distance of 0.9 m were designed for each treatment. The modified distance for the replications was 2 meters. Each maintained row was six meters long. All cultural activities were evenly dispersed throughout the crop's growing season across all treated plots in accordance with the IPM protocol. Confidor, also known as imidacloprid 20 SL, was selected as an insecticide with eight-day intervals. In a split plot experiment, three distinct pesticide levels were created for the treatments. Aphid-free, the first was subjected to three consecutive spraying activities on February 17, February 26, and March 6, 2015, eight days apart. The second was aphid protection, which involved applying a single spray on February 17, 2015, only when the plant was at its peak flowering stage. Aphid infestation (control) without spraying throughout the growing season was the third therapy.

### **Sampling of aphid's population**

From the beginning of the aphid infection until the crop reached maturity, weekly samples of the aphid populations were taken from six randomly chosen plants in each treatment. Aphid sampling dates were recorded four times between February 21, 2015, and March 25, 2015, at eight-day intervals. A 15 cm pencil-thick stick was used to gently trample each inflorescence of the top 15 cm six times. Aphids that had been dislodged were gathered on white paper sheets and counted by species.

### **Determination of phenological characters and yield**

Plant height (cm), pod length (cm), number of pods/plants, number of grains/pods, pod weight (five pods per plant), and thousand seed weight are significant phenological characteristics for determining yield and its components (2). By chopping one-meter-square plants, the experimental plot's total output was calculated, weighed, and converted to kilograms per hectare.

### **Analysis of data**

All recorded data were analyzed statistically using the Statistical Package for Social Sciences (SPSS). Descriptive statistics were calculated to summarize the data collected from different treatments. Analysis of variance (ANOVA) was performed to determine the significance of differences among treatments. The treatment means with significant differences were compared using the Least Significant Difference (LSD) test at a 5% level of significance. Graphs and tables were prepared to illustrate variations in phenological parameters and yield under different insecticide regimes using MS Excel.

## Calculation of yield losses

Yield losses were calculated by using following formulas given by Razaq et al., 2011. Aphid free - aphid infected / aphid free  $\times$  100 equals yield loss percentage Aphid free - aphid protected (one spray) / aphid free  $\times$  100 = yield loss percentage

## Results

The results revealed significant differences among insecticide treatments for all measured parameters. Aphid infestation caused a noticeable reduction in plant height, number of branches, number of pods per plant, and seed yield in the untreated control plots. In contrast, insecticide-treated plots showed significantly better plant growth and yield performance.

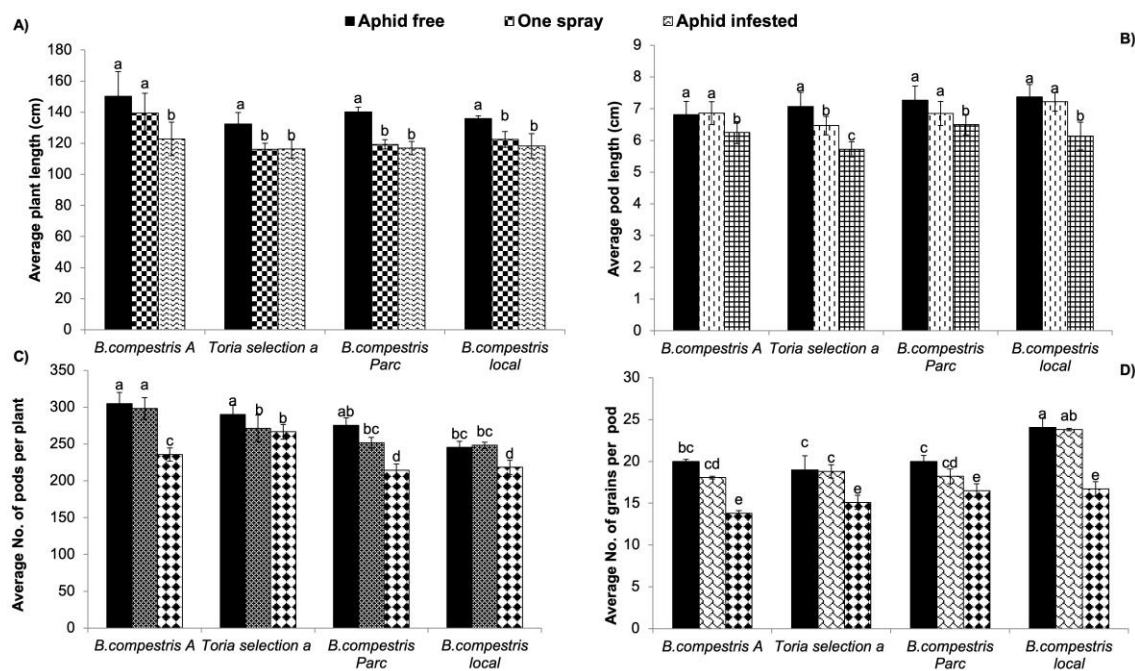
A clear variation was observed among different insecticide treatments in suppressing aphid population. Plots treated with highly effective insecticides exhibited a rapid decline in aphid density shortly after application, which was sustained throughout the observation period. This reduction in pest pressure contributed to improved plant vegetative growth and reproductive development.

Furthermore, phenological attributes such as days to flowering, pod formation, and maturity were positively influenced in treated plots compared to the control. Plants under effective insecticide regimes exhibited more uniform and timely development, indicating reduced stress from aphid infestation.

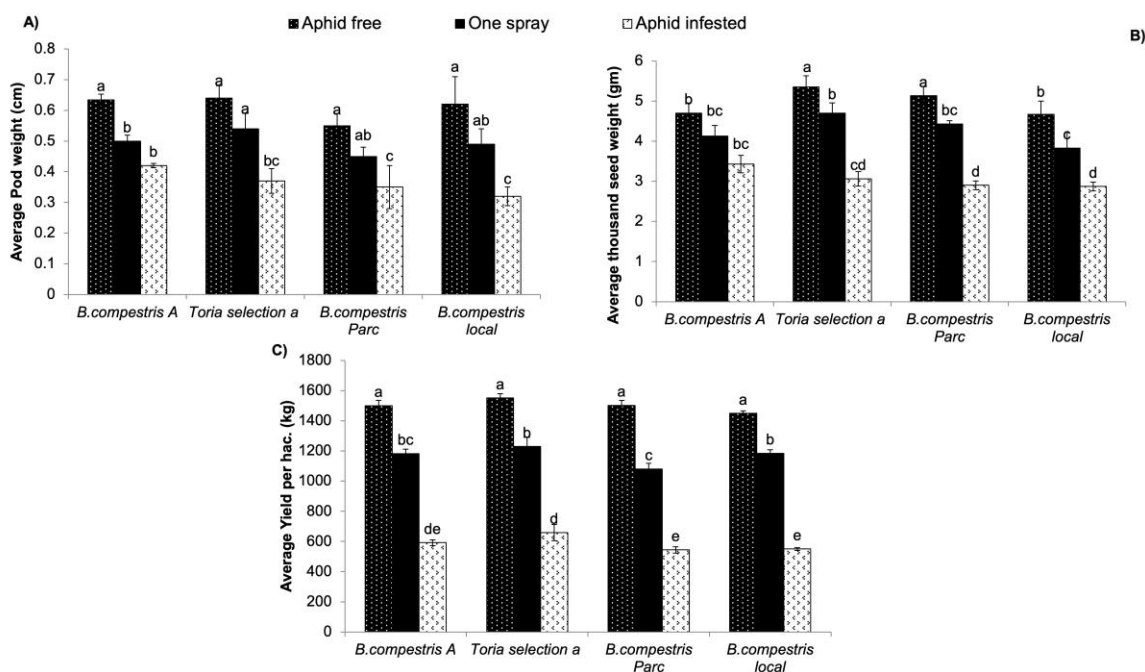
Among the tested treatments, certain insecticides proved significantly superior in reducing aphid population and enhancing yield-related traits. These treatments resulted in a higher number of pods per plant, increased seed weight, and ultimately greater seed yield per hectare. On the other hand, less effective treatments showed moderate control of aphids and comparatively lower improvement in growth and yield parameters.

Statistical analysis (e.g., ANOVA) confirmed that the differences among treatments were significant at the appropriate probability level ( $P \leq 0.05$ ), highlighting the reliability of the observed variations. The correlation between aphid population and yield parameters indicated a strong negative relationship, where increased aphid density led to substantial yield reduction.

Overall, these findings clearly demonstrate the importance of selecting effective insecticide regimes for managing aphid infestation. Proper chemical control not only reduces pest population but also enhances phenological development and maximizes yield potential in *Brassica campestris*.



**Figure 1:** Aphids herbivory effect on the yield and phenological parameters of plant, height of plant **A)**, length of pod **B)**, No/. of pods/ plant **C)**, No. of grains/pod **D)** of *B. campestris* varieties under different insecticides schemes. Different letters capped on the bars shows the significantly differences among treatments at  $P < 0.05$ . Error bars express  $\pm$  S.E.



**Figure 2:** Aphids herbivory effect on the yield and phenological parameters of plant, weight of pod **A)**, weight of thousand seeds **B)**, yield (kg)/ hectare **C)** of *B. campestris* varieties under different insecticides schemes. Different letters capped on the bars shows the significantly differences among treatments at  $P < 0.05$ . Error bars express  $\pm$  S.E.

1 **Table 1:** Average population of aphids from top 15 cm inflorescence in unsprayed plots of *B. campestris* cultivars at Multan during  
 2 2014-15.

Treatments	Sampling dates							
	21-02-2015		28-02-2015		07-03-2015		14-03-2015	
	<i>B.b</i> *	<i>L.e</i> *	<i>B.b</i>	<i>L.e</i>	<i>B.b</i>	<i>L.e</i>	<i>B.b</i>	<i>L.e</i>
<i>B. campestris</i>	39.88±3.03A	39.67±2.70B	35.35±2.02	43.53±5.75B	58.12±5.33	19.19±6.54B	49.70±4.95B	23.60±2.69C
Toria selection	19.97±3.09B	79.43±6.85A	30.19±2.13	35.15±5.75B	38.10±4.89	22.73±3.63A	36.73±4.71C	26.53±3.77BC
<i>B. campestris</i> PARC	24.30±2.89B	25.13±3.02B	29.66±3.95	38.18±2.56B	44.46±5.46	29.32±4.64A	62.60±5.95A	38.86±2.80A
<i>B. campestris</i> Local	16.17±1.70B	28.29±2.90B	32.43±3.78	69.17±4.14A	48.43±3.25	30.60±4.98A	52.20±3.23B	33.63±6.52AB
D.F	(3, 6)	(3, 6)	(3, 6)	(3, 6)	(3, 6)	(3, 6)	(3, 6)	(3, 6)
F-value	17.42	26.15	0.55	8.10	2.77	8.33	16.16	7.11
P-value	0.00	0.00	0.79	0.02	0.19	0.02	0.00	0.02
LSD-value	9.40	18.70	ns	12.62	Ns	11.40	12.60	9.99

3 Averages population with different letters in columns shown that they are statistically different  $P < 0.05$  ns shows the non-significant difference  
 4  $p > 0.05$ . \* *B.b* and \**L.e* shows *Brevicoryne brassicae* and *Liphaphis erysimi*, aphids.

5 **Table 2:** Average population of aphids from top 15 cm inflorescence of single sprayed plots on *B. campestris*, cultivars at Multan  
 6 during 2014-15.

Treatments	Sampling dates							
	21-02-2015		28-02-2015		07-03-2015		14-03-2015	
	<i>B.b</i> *	<i>L.e</i> *	<i>B.b</i>	<i>L.e</i>	<i>B.b</i>	<i>L.e</i>	<i>B.b</i>	<i>L.e</i>
<i>B. compestris</i>	4.57±1.09	3.56±1.40	12.10±2.02B	14.63±1.41	15.10±3.09C	26.27±2.30B	29.66±1.95B	23.36±1.44C
Toria selection	6.23±1.18	7.88±1.74	17.11±2.95AB	18.33±1.96	16.50±2.99BC	16.83±2.55B	28.12±1.19B	21.12±2.08BC
<i>B. compestris</i> PARC	8.43±0.92	4.99±0.90	20.43±1.97A	14.13±0.95	22.26±1.99AB	31.92±3.89A	36.00±3.01A	32.30±4.09A
<i>B. compestris</i> local	6.90±1.40	5.15±0.67	22.00±1.65A	19.23±1.67	23.99±3.18A	22.86±2.80B	44.12±3.49A	20.98±2.87AB
D.F	(3, 6)	(3, 6)	(3, 6)	(3, 6)	(3, 6)	(3, 6)	(3, 6)	(3, 6)
F-value	3.11	2.44	3.87	3.03	4.88	7.95	10.94	8.26
P-value	0.18	0.39	0.07	0.19	0.05	0.02	0.01	0.0
LSD-value	ns	ns	5.90	ns	8.14	11.88	7.75	9.89

7 Averages population with different letters in columns shown that they are statistically different  $p < 0.05$  ns shows the non-significant difference  
 8  $p > 0.05$ . \* *B.b* and \**L.e* shows *Brevicoryne brassicae* and *Liphaphis erysimi*, aphid

## 9 Discussion

10 Very aggressive and harmful feeding of Brassica species were observed by *B.*  
11 *brassicae* and *L. erysmi*. The dates of their occurrence and infestation were February  
12 21 and March 14, respectively. Despite *B. brassicae* infestation being non-significant  
13 among the second and third observed dates, aphid infestation was found to be  
14 significant among all observed dates reported in table 1 (Razaq et al., 2011). In the  
15 Multan and Bahawalpur regions, two aphid species were found in abundance in the  
16 first week of March and were scarce in the final week of the timely sown crop (Sarwar  
17 et al., 2004). In another study it was stated that aphid colonization began in the first  
18 week of February and peaked in the second week of February before declining in the  
19 first week of March (Jabeen & Farooq, 2021). In Pakistan, Aphid infestation appears  
20 in late February and peaked on March 22 before nearly vanishing, were likewise highly  
21 supported by the current study.

22 Aphids heavily attack observed on the plant flowering stage when sprayed at that time  
23 declining appeared which gradually built up but plant protect itself from massive threat  
24 of infestation at that time resulting in achievement of desired results (Table 2). Aphid  
25 colonization on different varieties was different significantly at ( $P < 0.05$ ) correlated to  
26 the results of Sarwar et al., (2004) that nos. of aphid and yield differed among cultivars  
27 and germplasms, and no genotype has been discovered to be immune to it. Royer et  
28 al., (2005) also correlated the observed approach that colonization of aphid's counter  
29 to insecticide rate in former and middle dates of planting.

30 Phenological parameters of plant such as height of plant (cm), length of pod (cm), nos.  
31 of pods/ plant, nos. of grains/ pod, weight of pod (gm) and thousand seeds weight (gm)  
32 were recorded through random selection of 06 plants from each replicate of different  
33 insecticide treatments. However, the unitary approach was used to compute the yield  
34 per hectare (kg). Insecticides treated plots resulted in significant increase in yield  
35 parameters such as nos. of pods/plant and yield as compared to untreated plots on  
36 late sown *Brassica spp.* by Brown in USA (Bakhetia et al., 1973). However, varietal  
37 response was non-significant among all the phenological characters of plant except  
38 for yield parameter only where significantly difference ( $P < 0.05$ ) was founded among  
39 the different varieties. Among the several *B. campestris* varieties, the interaction of  
40 varieties\*insecticides was not significant ( $P > 0.05$ ). Single-sprayed treatments shown  
41 their ability to recoup yield losses of up to 40%. (Figure 1 and Figure 2).

42 Calculated yield assessment losses in non-sprayed and single sprayed plots were  
43 60.451, 57.55, 63.89, 63.00 and 22.32, 20.93, 27.14, 20.41 % respectively. The  
44 present findings also strongly correlated with the findings of Iqbal et al., 2015 as they  
45 reported that aphids are serious pests of *Brassica napus* and heavily attack caused  
46 70-80 % yield losses. Losses in yield were calculated up to 27 to 96 % in India by  
47 Bakhetia et al., (1973) and Anwar et al., (2009). The present findings also supported  
48 by Razaq et al., 2011 that insecticides application on *B. juncea* significantly reduced  
49 the yield and its respective parameters. Anwar et al., 2009 and Sarwar et al., 2004  
50 reported that aphid population infestation per plant causes unconstructive approach

51 to yield and its attributes. Application of insecticides on mustard influenced yield  
52 parameters and seed significantly ( $P<0.05$ ) as compared to non-sprayed plots in  
53 Bangladesh by Shah et al., (2008).

## 54 **Conclusions**

55 Aphid colonization is the major delimiting factor of yield and imparts negative effect on  
56 phenological characteristics of the *B. campestris* cultivars. Insecticide expressed  
57 significant results ( $P<0.05$ ) to reduce the pest population while varietal treatment as  
58 well as their interaction variety \*insecticide was non-significant ( $P>0.05$ ). Single  
59 application of insecticide treatment (aphid protected) is helpful to save the crop up to  
60 40 % yield losses. Further need of this research is to be focused on other important  
61 cash crops.

62

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66 A.H. and M.R; writing—review and editing, S.N.

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