# PHYSICAL PLANT CHARACTERS OF CAULIFLOWER AND THEIR CORRELATION WITH *PIERIS BRASSICAE* L. (LEPIDOPTERA: PIERIDAE)

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**خلاصہ**

موجودہ تحقیقی عمل میں پھول گوبھی کے پودے کی ساخت کا گوبھی کی سنڈی Pieris brassicae کے ساتھ تعلق کو جانچا گیا ہے۔اس تجربے میں گوبھی کی دس اقسام White corona, Snow mystique, Snow grece, Local, Clima, 5340, Sydney, Snow crown, White magic AX-2034 کو تحقیقی عمل میں استعمال کیا گیا ہے۔ یہ تجربہ انٹامالوجی سیکشن ایگریکلچرل ریسرچ انسٹیٹیوٹ ترناب پشاور میں کیا گیا تھا۔ ۱۳-۲۰۱۲ میں پودے کی سب سے زیادہ اونچائی اور پتے کی لمبائی white magic پر ریکارڈ کی گئی جو کہ 63.5 سینٹی میٹر اور 54.86 سینٹی میٹر ہے۔ مشاہدے میں یہ بات بھی سامنے آئی کے گوبھی کے پتوں کی چوڑائی اور موٹائی میں کوئی خاص فرق نہیں پایا گیا۔ مختلف اقسام کے پتوں کی چوڑائی کی حد 434.3 سینٹی میٹر سے 1370.5 سینٹی میٹر تک ریکارڈ کی گئی ہے جبکہ پتوں کی موٹائی کی حد 0.3825 ملی میٹر سے 0.4975 ملی میٹر تک ریکارڈ کی گئی۔

۲۰۱۴-۲۰۱۳ کے تجربات میں سب سے زیادہ پودے کی اونچائی اور پتے کی لمبائی white magic پر 69.4 سینٹی میٹر اور 64.4 سینٹی میٹر ریکارڈ کی گئی۔ اس سال بھی تمام اقسام کے پتوں کی چوڑائی میں کوئی فرق ریکارڈ نہیں کیا گیا۔ پتوں کی موٹائی کی حد 536.17 سینٹی میٹر سے 1097.08 سینٹی میٹر تک رہی۔ پتے کی موٹائی سب سے زیادہ (Sydney) میں 0.485 ملی میٹر اور سب سے کم (Clima) اور (5340) پر 0.347 ملی میٹر تک ریکارڈ ہوئی۔ پھول گوبھی کی سنڈی کے انڈے، لاروں کی تعداد، گوبھی کی پیداوار اور گوبھی کے پودوں کی لمبائی، پتوں کی لمبائی اور پتوں کی چوڑائی میں گہرا تعلق پایا گیا ہے۔

**Abstract**

An experiment on Physical plant characters of cauliflower and their correlation with *Pieris brassicae* L. (Lepidoptera: Pieridae) was studied on ten cauliflower genotypes i.e, Snow mystique, White magic, Sydney, White corona, Local, Snow grece, Clima, 5340, Snow crown and AX-2034. The study was done under field condition at Entomology section ARI Tarnab Peshawar. During 2012-13 maximum plant height and leaf length was recorded on White Magic (63.5 cm) and (54.86 cm) respectively. No significant difference in leaf area and Leaf thickness was recorded among the ten cauliflower genotypes. The leaf area ranged from 434.3 cm (White Corona) to 1370.5 cm (Snow Grece) and leaf thickness ranged from 0.3825 mm( AX-2034) to 0.4975 mm(White Corona).During 2013-14 maximum plant height and leaf length was observed on White Magic i.e (69.4 cm) and (64.4 cm) respectively. Leaf area was non-significantly different among the 10 genotypes, where it ranged from 536.17 cm (Sydney) to 1097.08 cm (White Magic). Leaf thickness was significantly higher of Sydney (0.485 mm) while lower in each of Clima and 5340 (0.347 mm). *P. brassicae* egg, larval density and yield of cauliflower were positively correlated with physical plant characters (plant height, leaf length and leaf area) of cauliflower.

**Key words:** *Pieris brassicae;* physical characters; cauliflower; genotype; egg density, larval population, correlation

## Introduction

*P. brassicae* has attained important pest status of the *Brassica* family. *P. brassicae* female lays 20 to 100 yellow eggs in batches on brassicae family. The larvae are yellowish green with yellow lines and black spots and feed gregariously. Its chrysalis is also pale green with black spots. They hibernate as a chrysalis. It has two generations per year. (Asher, 2001) The quality of host plant during larval growth is the key factor which affect adults fertility, fecundity, ovi position sites, egg size and its quality. (Awmack and Leather, 2002). Aslam *et al.* (2000) reported that *P. brassicae* showed variations in preferring different cultivars of *Brassica spp*. This would be helpful in evolving resistant cultivars of Brassica against *P. brassicae*. Younas *et al.*, (2004) studied population dynamics of *P. brassicae* on different genotypes of cauliflower namely, Tropical, Snowdrift, Snowball, Meigettsal and Pioneer. Five genotypes were found susceptible to cabbage butterfly infestation. The highest number of larvae/plant (86.67) was observed in first week of November on Meigettsal. Larval population reduced to 0.67 larvae/plant in the first week of December on Snow Ball.

The aim of our study was to evaluate traits which are the best indicators of resistance in cauliflower genotypes and to find effective management tactics for *P. brassicae* control on cauliflower. For which we studied the role of various physio-morphic factors responsible for resistance in cauliflower against *P. brassicae*.

**Materials and Methods**

The research studies on correlation of physical plant characters of cauliflower and *Pieris brassicae* L. (Lepidoptera: Pieridae) was conducted during 2012-2014 in the field of Agricultural Research Institute Tarnab, Peshawar. Healthy seedlings (about 3-4″ tall) of 10 commercially available genotypes of cauliflower, i.e. Snow mystique, White corona, Snow grace, Clima, Local, 5340, Sydney, White magic, Snow crown and AX-2034 were transplanted on ridges in separate plots each measuring 4 m x 2m in the last week of September, 2012 & 2013. Row to row plant to plant and distance was kept at 75 cm and 45 cm respectively. The experiment was conducted in Randomized Complete Block Design (RCBD) having three replications. There were 30 plots and each plot contain 30 plants. Throughout the crop growing season standard agronomic practices were applied to all the treatments.

The following parameters regarding the physical plant characters were recorded by randomly selecting five leaves plant$^{-1}$, with a total of five plants genotype$^{-1}$.

**Plant height (cm):** Plant height of cauliflower genotypes was recorded with the help of a measuring tape by randomly selecting five plants genotype$^{-1}$ in each replication from ground level to the top of plant. The average plant height was calculated.

**Leaf length (cm):** Five leaves were randomly selected from each genotype of all the three replications from base of leaf to top of leaf using a measuring tape. The average length leaf$^{1}$ was recorded.

**Leaf thickness (mm):** Leaf thickness of cauliflower leaves was recorded with the help of digital Vernier Caliper by randomly selected five leaves plant$^{-1}$ and five plants in each genotype of the three replications. The average leaf thickness was calculated.

**Leaf area (cm$^2$):** Leaf area of cauliflower leaves was measured by leaf area machine LICOR, LI-3100 by passing nine leaves of each genotype and then average leaf area was calculated.

**Results and Discussion**

The ten cauliflower genotypes differed significantly for physical plant characters (Table 1). Maximum plant height was recorded of White Magic (63.5 cm) while minimum of White Corona and Sydney (41.91cm and 41.15 cm), respectively. Maximum leaf length was recorded on White magic (54.86 cm) while minimum on Sydney (35.3 cm). No significant difference in leaf area was recorded among the ten cauliflower genotypes. During 2012-13 the leaf area ranged from 434.3 cm of White Corona to 1370.5 cm of Snow Grece. Leaf thickness of all the genotypes was non-significantly different from each other and it ranged from 0.3825 mm of AX-2034 to 0.4975 mm of White Corona.

Physical plant characters of 10 cauliflower genotypes were significantly different from each other during 2013-14 (Table 2). Maximum plant height was observed of White Magic (69.4 cm) while minimum of White Corona (45.4 cm). Maximum leaf length was also recorded on White Magic (64.4 cm) while minimum in Sydney (41.2 cm). Leaf area was non-significantly different among the 10 genotypes, where it ranged from 536.17 cm (Sydney) to 1097.08 cm (White Magic). Leaf thickness was significantly higher of Sydney (0.485 mm) while lower in each of Clima and 5340 (0.347 mm).

**Table 1. Physical plant characters of 10 cauliflower genotypes during 2012-2013.**

| Genotype | Plant height (cm) | Leaf length (cm) | Leaf area (cm$^2$) | Leaf thickness (mm) |
|---|---|---|---|---|
| White Corona | 41.91 f | 37.08 de | 434.3 a | 0.4975 a |
| Snow Mystique | 45.46 ef | 39.87 cde | 745.9 a | 0.4825 a |
| Snow Grece | 46.48 ef | 46.48 bc | 1370.5 a | 0.475 a |
| Local | 59.94 ab | 46.73 bc | 1055.9 a | 0.4575 a |
| Clima | 54.35 bcd | 47.75 ab | 894.7 a | 0.4925 a |
| 5340 | 50.8 cde | 43.18 bcd | 699.3 a | 0.44 a |
| Sydney | 41.15 f | 35.3 e | 761.4 a | 0.4325 a |
| Snow Crown | 56.38 abc | 44.95 bc | 980.2 a | 0.3925 a |
| White Magic | 63.5 a | 54.86 a | 825.5 a | 0.475 a |
| AX-2034 | 48.51 def | 40.64 bcde | 681 a | 0.3825 a |
| LSD (0.05) | 7.7511 | 7.1843 | 1039.7 | 0.1221 |

Means in columns having similar letters are significantly similar at $\alpha = 0.05$ (LSD test).

**Table 2. Physical plant characters of 10 cauliflower genotypes during 2013-2014.**

| Genotype | Plant height (cm) | Leaf length (cm) | Leaf area ($cm^2$) | Leaf thickness (mm) |
|---|---|---|---|---|
| White Corona | 45.4 e | 43 d | 827.92 a | 0.422 abc |
| Snow Mystique | 65.4 a | 60.2 ab | 927.49 a | 0.48 ab |
| Snow Grece | 64.2 ab | 58.4 b | 775.05 a | 0.412 abc |
| Local | 68.4 a | 64 a | 1090.37 a | 0.435 abc |
| Clima | 57.2 c | 51.2 c | 672.82 a | 0.347 c |
| 5340 | 54.8 cd | 51 c | 933.85 a | 0.347 c |
| Sydney | 47.2 e | 41.2 d | 536.17 a | 0.495 a |
| Snow Crown | 58 bc | 51.4 c | 1068.87 a | 0.41 abc |
| White Magic | 69.4 a | 64.4 a | 1097.08 a | 0.46 abc |
| AX-2034 | 49.8 de | 41.4 d | 758.78 a | 0.37 bc |
| LSD (0.05) | 6.2287 | 4.8849 | 611.80 | 0.1196 |

Mean in columns having similar letters are significantly similar at $\alpha = 0.05$ (LSD test)

**Correlation among various physical plant characters with *P. brassicae* egg density plant$^{-1,}$ larval population plant$^{-1}$and yield of cauliflower**

Table 3 showed that correlation among various cauliflower physical plant characters and *P. brassicae* egg and larval density and yield of cauliflower was significant ($p < 0.01$) between egg density and plant height, and egg density and leaf length ($p < 0.05$), but non-significant between egg density and leaf area, and egg density and leaf thickness.

The correlation coefficient between larval population and plant height and larval population and leaf length was significant ($p < 0.01$). It was significant for larval population and leaf area ($p < 0.05$) but non-significant for larval population and leaf thickness.

The results of correlation coefficient between cauliflower yield and various physical plant characters showed that correlation was significant between yield and plant height ($p < 0.05$) and yield and leaf length ($p < 0.05$), but non-significant between yield and leaf area and yield and leaf thickness.

**Table 3. Correlation among various cauliflower physical plant characters with *P. brassicae* egg density plant$^{-1,}$ larval population plant$^{-1}$ and yield of cauliflower genotypes during 2012-14.**

| | Correlation coefficient (r value) | | |
|---|---|---|---|
| Physical plant factor | Egg density | Larval population | Yield |
| Plant height (cm) | $0.5803^{**}$ | $0.7661^{**}$ | $0.5297^{*}$ |
| Leaf length (cm) | $0.5494^{*}$ | $0.7606^{**}$ | $0.5416^{*}$ |
| Leaf area | $0.4015^{ns}$ | $0.4490^{*}$ | $0.1323^{ns}$ |
| Leaf thickness | $0.3401^{ns}$ | $0.0561^{ns}$ | $-0.1545^{ns}$ |

** = Significant at $p < 0.01$; * = Significant at $p < 0.05$; ns = Non significant

The correlation coefficient between larval population and plant height and larval population and leaf length was significant ($p < 0.01$). It was significant for larval population and leaf area ($p < 0.05$) but non-significant for larval population and leaf thickness.

The present results are similar to that of some earlier researchers. Hasan and Ansari (2010) reported that *P. brassicae* population parameters, development, survival, reproduction, and life table are affected by biotic and abiotic factors including host plant characters. *P. brassicae* egg laying behavior is affected by plant color and plant size as both are long distance clues (Radcliff and Chapman, 1966; Metspalu *et al.,* 2009).

Stamp 1(980) and Masurier (1994) reported that *P. brassicae* tend to lay maximum eggs when locating large-sized hosts with abundant leaves. Picoaga *et al.* (2003) revealed that general appearance of plant may be a useful indicator of resistance. Phenotypically glossy leaves of kale accessions are related to resistance.

Gutbrodt (2012) stated that *B. oleracea* plants express significant variation of resistance within-plant and leaf age related to insect herbivores. Furthermore, the biotic environmental factor 'herbivore damage' and abiotic environmental factor 'drought stress' evoked significant variation in *B. oleracea* resistance.

In present study leaf area was larger in Snow Grece (1370.9 $cm^2$) and White Magic (1097.08 $cm^2$) and smaller in White Corona (434.3 $cm^2$) and Sydney (536.17 $cm^2$) during 2012-13 and 2013-14. Leaf thickness was more in White Corona (0.975 mm) and Sydney (0.495 mm) and less on AX-2034 (0.3825 mm) and Clima (0.347 mm) during 2012-13 and 2013-14. But egg density of *P. brassicae* was non-significantly correlated with leaf area and leaf thickness of cauliflower genotypes. Eigenbrode *et al.* (1991) reported that oviposition preferences of *Plutella xylostella* L. on different cabbage cultivars showed that resistant cabbage cultivars had different chemical composition and thicker wax layer from that of non-resistant cultivars. And resistant cultivars

wax layer contained more primary alcohols than the susceptible cultivars. Wax coating of leaves prevents the discharge of specific odors from the leaves and makes it difficult for *P. brassicae* females to obtain information of the chemical composition of leaves (Metspalu *et al.,* 2009). In natural infestations on glossy lines there was 80% less *Pieris rapae* (L.) infestation than on normal-wax standard varieties of cauliflower (Stoner and Kimberly, 1992).

By visual examination we assumed that White magic and local genotype has dark green color than Ax-2034 and Sydney. Metspalu *et al.* (2009) reported that cabbage 'Parel' and 'Golden Acre' have lighter colored leaves, i.e. yellowish green color, which avoid *P. brassicae* for egg laying while cultivars having dark green leaves attract *P. brassicae* for oviposition. Myers (1985) reported that *P. rapae* female approaches to greener plants for oviposition.

In present study larval population was positively correlated to plant height, leaf length at $P < 0.01$ and leaf area ($P < 0.05$) but it was not correlated with leaf thickness of the cauliflower genotypes. Awmack and Leather (2002) and Hasan and Ansari (2011) reported that host plant quality plays a vital role in larval population dynamics and affecting larval growth and development as well as adult fecundity and fertility. Cauliflower yield was positively correlated with plant height and leaf length ($P < 0.05$), but it was not correlated with leaf area and leaf thickness.

## Conclusion

It is concluded that *P. brassicae* egg, larval density and yield of cauliflower were positively correlated with physical plant characters (plant height, leaf length and leaf area) of cauliflower.

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