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Effect of Micro Climate on Flowering Characteristics in Grapes (*Vitis vinifera* L.)

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ABSTRACT
The study aimed to find out the effect of micro climate on flowering characteristics in grapes varieties viz. Perlette, Flame Seedless, Superior Seedless and Punjab Purple. The experiment was conducted in Punjab-Ludhiana during 2018-19 fruiting seasons. Grape varieties were grown in both protective covering (Greenhouse) and open field. The data recorded showed that temperature and relative humidity was higher in protective covering with comparison to open field. The result of the experiment showed advancement in flowering characteristics viz. time of bud-burst, flowering initiation and fruit set in grape varieties grown under protective covering as compared to those grown in open field condition. Maximum advancement in bud burst was observed in Perlette variety (9 and 5 days earlier). Flower initiation was advanced by 4 days in Flame Seedless and Superior Seedless varieties and fruit set by 3-10 days in Punjab Purple variety grown in protective covering.

Keywords: Protective Covering, Micro Climate, Grape varieties, Flowering Characters

INTRODUCTION
Grape (*Vitis vinifera* L.) is one of the important fruit crop in world grown commercially in temperate, tropical and sub-tropical regions. Grapes are used for various purposes like wine, jam, raisin, jelly and juice. Grape berries are attractive for their unique flavour and are utilized in many different ways. About 71 per cent of the world total production of grapes is used in preparing wine, 27 per cent as fresh fruit, and 2 per cent as dried fruit (FAO, 2012). The demands for grapes are increasing day by day throughout the world because of the huge potential of grapes in improving immune system of human (Sindhu and Radhai, 2015).

Grape is a good source of phyto-chemicals which fights chronic diseases, like some kinds of cancer and cardiovascular diseases. Various studies have shown that grapes have good antioxidant activities that can inhibit cancer cell proliferation and put down platelet aggregation, and grapes also decrease cholesterol. Grapes contain different kinds of phyto-chemicals, like proanthocyanidins, anthocyanins, stilbenes, and phenolic acids so all of these phyto-chemicals act as vigorous antioxidants (Yang et al., 2009).

Largest producer country of grapes is China with an annual production of 9.60 MT, followed by Italy, USA, France and Spain. India has ranked 9th amongst major grapes producing countries with an annual production of 2920.0 thousand tonnes from an area of 139 thousand hectares (NHB, 2018).

Protected cultivation is a unique and specialized form of agriculture. Very important factor in horticultural crops production is the climate. During the past many decades, cultivation in Rain-shelter has been studied for its commercial value on table grapes and some other fruits (Tangolar et al., 2007; Fanizza and Ricciardi, 1991; Junior et al., 2011 and Chavarria et al., 2011).The overall objectives of cultivation in protective covering is that, it can change and adjust the natural environment by some structures and practices to get best productivity of crops through improving yields and product quality, expanding the area of production and extending the effective harvest period of the product (Wittwer and Castilla, 1995).

Growing vines under protected conditions is an attractive alternative for growing good quality grapes under adverse agro climatic conditions. Even by this technique farmer can harvest grapes in off season or enhance the fruit quality by extending the fruit development period under protected condition.

Under the environmental conditions of the Apulia region, which is the main region for table grape production in Italy, the early-covering technique has proved to improve quality and quantity of grape production, either in seedless or seeded varieties (Novello et al., 1998, 2000; Tarricone, 2003).

The date of harvest of grapes can be advanced by encouraging a precocious bud-break through covering the lateral belts and roof of vineyard with transparent plastic films that can permit big amount of solar radiation to pass through and then were able to retain a proper percentage of energy through reducing the radiative and convective thermal dispersions. Hence, the temperature of air rises and it convinces a rapid accumulation of growing degree days that encourages an earlier bud-burst of vine (Novello and Palma, 2008).

Covering of grapevines like Yalova Incisi, Round Seedless and Cardinal with plastic cover advanced the dates of phenological stages like bud-burst, flowering, verasion and ripening. Plastic covering hastened bud burst from 17 to 31 days as compared to vines grown in the open field condition. Bud-burst of Yalova Incisi was 7 to 10 days earlier grown in plastic cover as compared to Round Seedless and Cardinal in 2004 (Coban, 2007).

Flowering was advanced by plastic covering 25-27 days in Yalova Incisi, 35-39 days in Round Seedless and 31-33 days in Cardinal varieties of grapes, depending on the years. The colour break stage (verasion) was advanced by 31 days in Round Seedless, 23 days in Yalova Incisi and 28 to 30 days in Cardinal grape varieties (Coban, 2007). According to the mean values of 2004-2005 and 2005-2006 seasons, the phenologic periods were observed earlier in protected plants than in those grown in an open field. As can be seen from Table 1, vines under cover reached bud break 9 days early, full bloom 14 days early, veraison 16 days early, and maturity 17 days early (Kamiloğlu et al., 2011).

El-Saeed et al. (2015) studied the effect of plastic greenhouse for early production of Thompson Seedless grape. The protection treatments earliness the full bloom by about 39 days and caused both early fruit set and early harvest date (50%) by about 15 days, compared to outdoor. The whole period of development was shifted to 15 days or 5-7 and 10 days earlier as a result of plastic house or tunnels respectively than in uncovered vines, during the 1st and 2nd seasons, respectively. Uzun (1993) reported that covering the grapevines with plastic is eff ective in speeding up phenologic stages; the 'Perlette' cultivar matured 15-17 days and the 'Bağdat siyahı' matured 16-10 days earlier in that study.

MATERIALS AND METHODS

The investigation was carried out in the Fruit Research Farm and Post Graduate Laboratory, Department of Fruit Science, Punjab Agricultural University, Ludhiana, during 2018 and 2019 fruiting seasons.

The experiment was conducted on own rooted vines of Perlette, Flame Seedless, Superior Seedless and Punjab Purple grapes grown in protective structure and open field condition, which were pruned to 4 buds level during first fortnight of January. Under Punjab conditions, this time is recommended for pruning grapes. These vines received uniform cultural practices during the study periods.

Experimental design and treatments

- Design = Factorial Randomized Block Design (RBD)
- Treatment 1 (T_1) = Grapevines grown in permanent protecting structure
- Treatment 2 (T_2) = Grapevines grown in open conditions
- No. of varieties = 04 (Perlette, Flame Seedless, Superior Seedless and Punjab Purple)
- No. of treatments = 02
- No. of replications per treatment = 3
- No. of vines per replications = 5
- No. of experimental vines = 4 x 2 x 3 x 5 = 120

The following parameters were recorded during the study:

1: Time of bud burst

From the beginning of the February, each variety was observed every day for bud burst and the time of bud burst was recorded when 75 % bud burst was noted in each variety.

2: Flower initiation

Each variety was observed every day during first fortnight of March for flower initiation and the time of flower initiation was considered when 75 % flowers were initiated.

3: Completion of flowering

Each variety was observed every day for completion of flowering and the time of completion of flowering was recorded when there was no more flower initiation observed.

4: Duration of flowering (days)

The number of days from the flower initiation till the completion of flowering were counted as duration of flowering.

5: Time of fruit-set

From third week of March, each variety was observed every day for occurrence of fruit-set and the time of fruit-set was recorded when more than 75% flowers were set.

RESULTS AND DISCUSSION

1: Time of bud burst

The observations regarding effect of protective covering on time of bud burst are given in Table 1. The data revealed that T1 caused 6-9 days earlier bud burst as compared to T2. Earliest bud burst was observed on 17th February during 2018 and on 22nd February in 2019 in Perlette grapes grown under protected condition as compared to open field condition in which bud burst was occurred on 26th February and 27th February during 2018 and 2019, respectively. In Flame Seedless grapes grown in protective covering, bud burst was advanced by 9 days and 5 days during 2018 and 2019, respectively. Likewise, Coban (2007) reported that covering of grapevines of Yalova Incisi, Round Seedless and Cardinal with plastic covers advanced the dates of phenological stages such as bud burst, flowering, verasion and ripening. Plastic covering hastened bud-burst for 17-31 days as compared to vines grown in the open field. An increment of the mean or maximum, daily temperature is known to advance the grapevine budbreak (Pouget, 1967; McIntyre et al., 1982).

Flower initiation

The data related to the effect of protective covering on time of flower initiation are given in Table 1 showed that earliest flower initiation was recorded on 26th February in 2018 and 8th March in 2019 in Perlette grapes of T1 as compared to T_2 in which flower initiation was occurred on 1st March and 12th March during 2018 and 2019, respectively. In Flame Seedless grapes of T1, flower initiation was occurred on 27th February 2018 and 13th March 2019 resulted in advancement of flower initiation by 4 days and 5 days, respectively, as compared to T2. Coban (2007) stated that covering grapes with plastic covers advanced flowering 25 to 27 days in Yalova Incisi, 31 to 33 days in Cardinal and 35 to 39 days in Round Seedless grapes, depending on the years and colour break stage (verasion) 23 days in Yalova Incisi, 28 to 30 days in Cardinal and 31 days in Round Seedless varieties of grape.

Table 1: Effect of protective covering and open field condition on time of bud burst and flower initiation in grapes

Variety	Time of Bud Burst				Flowers Initiation			
	2018		2019		2018		2019	
	PC*	OF*	PC	OF	PC	OF	PC	OF
Perlette	17-Feb	26-Feb	22-Feb	27-Feb	26-Feb	01-Mar	08-Mar	12-Mar
Flame Seedless	22-Feb	02-Mar	25-Feb	02-Mar	27-Feb	03-Mar	13-Mar	18-Mar
Superior Seedless	23-Feb	01-Mar	28-Feb	02-Mar	28-Feb	04-Mar	14-Mar	18-Mar
Punjab Purple	25-Feb	03-Mar	11-Mar	18-Mar	02-Mar	04-Mar	19-Mar	24-Mar

*PC = Protective condition; *OF = Open field condition

Completion of flowering

The data with respect to the effect of protective covering on completion of flowering are given in Table 2 revealed that earliest completion of flowering was observed in Perlette and Punjab Purple grapes (Punjab Purple grapes in 2018) under T1. In Perlette grapes, completion of flowering was observed on 12th March in 2018 and 24th March in 2019 resulted in shortening of flowering period by 2 days and 1 day during 2018 and 2019,

respectively, as compared to T2. In Flame Seedless variety of grapes grown in protective covering completion of flowering was occurred on 13th March in 2018 and 25th March in 2019 resulted in shortening of flowering period by 2 days in both years as compare to open field condition. Likewise, El-Saeed *et al.* (2015) stated that protection treatments result in earliness of full bloom in Thompson Seedless grapes by about 39 days and caused both early fruit set and early harvest date (50%) by about 15 days, compared to outdoor condition.

Duration of Flowering (Days)

The data regarding the effect of protective covering on duration of flowering are presented in Table 2. The data showed that in protective covering flowering duration ranges from 13 -15 days in 2018 and from 8-16 days in 2019 as compared to 12-14 days (2018) and 6-14 days (2019) in open field condition.

Table 2: Effect of protective covering and open field condition on flowering in grapes

Variety	Completion of Flowering				Duration of Flowering			
	2018		2019		2018		2019	
	PC*	OF*	PC	OF	PC	OF	PC	OF
Perlette	12-Mar	14-Mar	24-Mar	25-Mar	14	14	16	13
Flame Seedless	13-Mar	15-Mar	25-Mar	27-Mar	15	13	12	14
Superior Seedless	14-Mar	15-Mar	26-Mar	28-Mar	13	12	12	10
Punjab Purple	12-Mar	14-Mar	27-Mar	30-Mar	13	14	8	6

*PC = Protective condition; *OF = Open field condition

Time of fruit-set

The observations regarding effect of protective covering on fruit set are presented in Table 3. The data revealed that earliest fruit set was observed on 28th March in 2018 and 12th April in 2019 in Perlette variety of grapes grown under protective covering resulted in advancement of fruit set by 9 and 2 days, respectively, as compare to T_2 (open field condition) in which fruit set was observed on 6th April in 2018 and 14th April in 2019. In Punjab Purple grapes, fruit set occurred on 30th March in 2018 and 16th April in 2019 under protective covering resulted in advancement of fruit set by 10 and 3 days, respectively. In Flame Seedless variety of grapes, time of fruit set was recorded on 31st March in 2018 and 15th April in 2019 grown under protective covering resulted in advancement of fruit set by 8 and 3 days, respectively, as compared to T_2 (open field condition). Likewise, El-Saeed *et al.* (2015) stated that protective covering caused early fruit set date (50%) by about 15 days, compared to outdoor condition.

Table 3: Effect of protective covering and open field condition on time of fruit set and colour break stage in grapes

Variety	Time of Fruit Set			
	2018		2019	
	PC*	OF*	PC	OF
Perlette	28-Mar	06-Apr	12-Apr	14-Apr
Flame Seedless	31-Mar	08-Apr	15-Apr	18-Apr
Superior Seedless	05-Apr	10-Apr	16-Apr	19-Apr
Punjab Purple	30-Mar	09-Apr	16-Apr	19-Apr

*PC = Protective condition; *OF = Open field condition

CONCLUSION

Protective cultivation is a sustainable alternative for increasing productivity, while reducing the negative effects of climate change and minimizing the incidence of pests and diseases at the same time. It also allows regulation of macro- and microenvironments, facilitating optimal plant performance, induction of earliness, and obtaining higher and better quality yields. The present study concludes that there was advancement in flowering characteristics viz. time of bud-burst, flowering initiation and fruit set in grape varieties grown in protective covering which causes induction of earliness. The farmer would supply good quality products to the market before the prices get lowered due to saturation of the market.

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