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# Effect of Dormex, CPPU and $GA_3$ on berry growth and ripening of Pusa Seedless cultivar of grape

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## Abstract

The effects of Dormex (40% aqueous Hydrogen Cyanamide), CPPU [N-(2-Chloro-4-Pyridyl)-N'-phenylurea] and $GA_3$ on berry growth and ripening of Pusa Seedless cultivar of grape (*Vitis vinifera* L.) trained on telephone system were studied. The vines were treated with 1.5% Dormex (40% aqueous Hydrogen Cyanamide) solution immediately after pruning (January 4). The flowers of Dormex treated plants (D) were treated with $GA_3$ (45 ppm) at full bloom stage and CPPU (0.1%) after fruit set, in combination of D+CPPU and D+$GA_3$+CPPU. Dormex application induced early bud break by 30 days and enhanced ripening by 7 days in comparison to control. Both control and D grape berries followed double sigmoidal growth pattern. The berries of treatment D+CPPU and D+$GA_3$+CPPU did not have the lag phase of growth in terms of fresh weight although they followed double sigmoidal growth pattern in terms of dry weight. The bunches from dormex treated plants were harvested 10 wk after flowering (AF), whereas that from the control plants, harvested 9 wk AF. The final berry weight was highest in $T_3$ (30.24 g) followed by $T_2$ (15.8 g). TSS of the berry was highest in case of D+$GA_3$+CPPU.

**Key words**: *Vitis vinifera,* grape, hydrogen cyanamide, bloom, berry growth, quality, $GA_3$, cytokinin

## Introduction

Grape (*Vitis vinifera* L.) is one of the important fruit crops of India. Pre-monsoon showers during berry ripening, leading to rotting and cracking of berries is a major problem of grape cultivation in northern India (sub-tropical conditions). Inducing early bud break is one of the proved methods of hastening ripening in grape. Dormex has been found to hasten bud burst and advance berry ripening in Pusa Seedless, a mid maturing, cane pruned promising cultivar of North India (Pandey, 1989). Pusa Seedless grape berries show a double sigmoid growth curve with 3 distinct periods of growth (Farmahan and Pandey, 1977). The first phase of rapid growth is associated with high levels of auxin like substances and low levels of inhibitory substances. This is followed by a period of slow growth called lag phase, which is characterized by low level of growth promoting substances and high level of inhibitor in the berry. The last period of rapid enlargement is associated with high level of gibberellin like substances (Farmahan and Pandey, 1977).

Various growth regulators have been tried to modify the grape berry growth. Intrierie *et al.* (1992) reported an increase in berry size by the application of CPPU, a cytokinin substitute [N-(2-Chloro-4-Pyridyl)-N'-phenylurea] in seedless table cultivars of grape. But its effect on ripening pattern was not significant. Retamales *et al.* (1993) reported increased berry weight and soluble solid in cv. Sultanina, by application of CPPU with or without $GA_3$.

Keeping this in view, the experiment was conducted to determine the effect of Dormex, $GA_3$ and CPPU in different combinations on berry growth and ripening of Pusa Seedless grape grown under North Indian conditions.

## Materials and methods

Fifteen year old healthy, own rooted vines of *Vitis vinifera* L. cv. Pusa Seedless, trained on telephone system, grown under New Delhi, India condition were selected. The vines were pruned on 4 Jan. 1998, retaining 8-10 buds per cane and 13 canes per vine. Immediately after pruning (5 Jan.) the vines were sprayed with 1.5% Dormex (40% aqueous Hydrogen Cyanamide) solution. The flowers of Dormex treated plants were treated with $GA_3$ and CPPU in different combinations, by dipping the bunches in 45 ppm $GA_3$ solution at full bloom stage and 0.15% CPPU after fruit set stage, respectively.

Treatment combinations

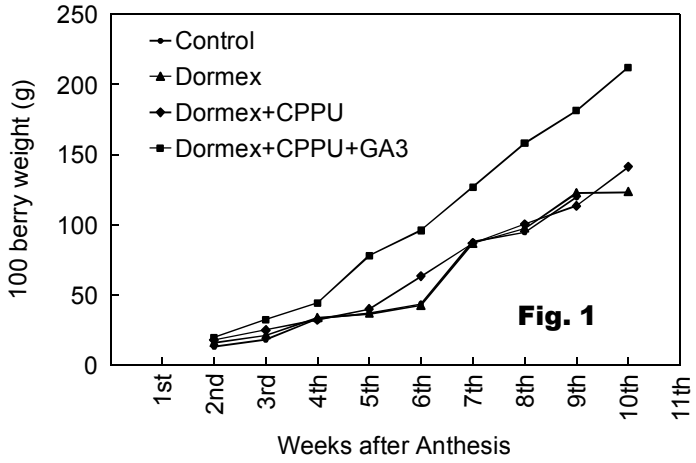
- $T_0$ Control
- $T_1$ Plants treated with Dormex
- $T_2$ $T_1$ + bunches dipped in 0.15% CPPU solution after fruit set.
- $T_3$ $T_2$ + bunches dipped in 45 ppm $GA_3$ solution at full bloom stage

The treatments were replicated 3 times. Berries were sampled at random from middle portion of the healthy bunches at weekly interval starting from 2 weeks after flowering, until harvest and the observations were recorded on fresh and dry weight (100 berries) and TSS.

## Results

In Pusa Seedless grape, application of Dormex hastened bud break by 30 days. The Dormex treated plants came to full bloom by 3 April which was 12 days earlier than that in control plants (15 April).

**Berry fresh weight**: In control plants there was a gradual increase in berry weight up to 4th week of flowering (Fig. 1). Then the rate of growth slowed down until 6th week after flowering. There was a sudden increase in berry weight after 6th week until harvest (end of 9th week). The above growth pattern was similar to the double sigmoidal growth pattern of Pusa Seedless grape that was reported by Farmahan and Pandey (1977). The berry growth pattern of Dormex treated plants was almost similar to that of control plants except that there was no change in berry weight in the 10th week. The final berry weight (123.17 g) was higher than control plants (119.67 g). In case of $T_2$, there was a gradual increase in berry weight up to 5 week after flowering and the rate of increase was higher up to harvest. There was no period of slow growth rate or lag phase. The final berry weight was higher than control and $T_1$ (141.34 g).



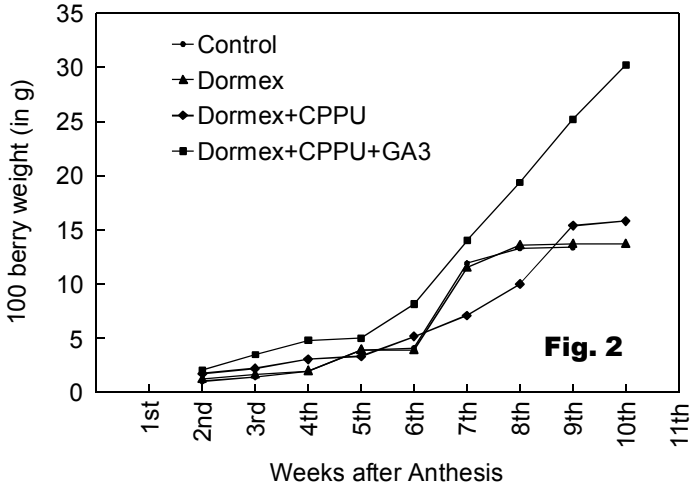




**Fig. 1.** Changes in average berry fresh weight (100 berries) upon development of Pusa seedless grapes

**Fig. 2.** Changes in average berry dry weight (100 berries) upon development of Pusa seedless grapes

In case of $T_3$, a gradual increase in berry weight was observed up to 4th week after flowering then the berry weight increased sharply until harvest. The final berry weight was higher than all other treatments (212 g).

**Berr dry weight**: In terms of dry weight, both control and $T_1$ showed almost similar berry growth pattern. Five weeks after flowering, a distinct lag phase was observed (Fig. 2). In $T_1$, a slight reduction in berry weight was observed during the lag phase. There was a sudden increase in berry weight during the 7th week after which the rate of growth declined. In $T_1$, the berry weight declined slightly during the 10th week (13.72-13.71 g).

In $T_2$ and $T_3$, there was a period of slow growth up to 4th week after which the growth almost ceased and the lag phase was distinct. After the 5th week, there was a sharp increase in berry weight. In $T_2$, there was a significant decline in rate of growth as obvious from the slope of the curve, after 9th week of flowering. It did not have the lag phase of growth in terms of fresh weight, but it was present in terms of dry weight. In these cases, the lag phase (dry weight) was induced 7 days earlier than $T_1$ and control ($T_0$) berries. The berry growth period was prolonged in $T_2$ and $T_3$ treated plants and the ripening date was same as control plants. Both CPPU and $GA_3$ increased final berry weight significantly.

**Total Soluble Solid ($^o$Brix)**: No significant difference in TSS was observed among the treatments $T_0$ (18.33$^o$Brix), $T_1$ (18.56$^o$Brix) and $T_2$ (18.46$^o$B). The TSS was highest in $T_3$ (19.26$^o$B).

## Discussion

In this experiment, we have tried to study the effect of Dormex, CPPU and $GA_3$ (incombination) during berry development of Pusa Seedless grape. Dormex has been found successful in inducing early bud break, similar to the observation recorded by Pandey (1989). The duration taken from bud burst to flowering was 53 days in case of Dormex treated plants, whereas it was 36 days in control. Farmahan and Pandey (1978) has reported complete dependence of grape berries on current season growth for carbon source. Hence, higher amount of photosynthate reserve from current season growth, due to longer photosynthetic activity, in Dormex treated plant may attribute to their higher initial berry weight.

Application of Dormex enhanced bud break by 30 days, but flowering was enhanced by 12 days. Although berries from all the treatments were harvested at the same time, $T_1$ plant berries attended ripened stage, around 7 days earlier, which is obvious from the plateau in the fresh weight curve during the last week. The berry dry weight curve, indicates termination of dry matter accumulation in berry, at the end of 8th week after flowering. The slight reduction in dry weight in the 10th week, may be due to utilization of glucose as a substrate for respiration in the ripening grape berries, although the rate of respiration of grape berries decreases during ripening (Winkler *et al.*, 1974). So hastening ripening effect of Dormex can be considered to be due to its effect on early bud break, than on berry growth, since both in control and $T_1$, berries took 9 week to attain ripening stage. This is also obvious from the similar berry growth pattern of $T_0$ and $T_1$.

Absence of distinct lag phase in berry growth (fresh weight) pattern of CPPU and $GA_3$ treated plants indicate their effect on berry growth.

The rate of berry growth in Dormex + CPPU treated plants is almost similar to that of control and Dormex treated plants. The increase in berry weight (fresh weight) can be attributed to prolonged development period of the berries and absence of lag phase. In terms of berry dry weight, the lag phase was distinct during 4th week of growth, which was one week earlier than that observed in control and Dormex treated plants. Alleweldt

*et al.* (1975) reported sharp increase in cytokinin content during the lag period of berry growth which decrease during next rapid growth stage. High cytokinin level may interact with other factors in triggering of conditions necessary for inducing lag phase. In our experiment, early inhibition of dry matter accumulation in CPPU treated berries may be a result of above mentioned process.

Total lack of lag phase in Dormex + $GA_3$ + CPPU treated berries indicates the synergistic effect of $GA_3$ with CPPU in overcoming the lag phase. The early onset of lag phase in berry dry weight growth pattern, may be attributed to the effect of CPPU. Farmahan and Pandey (1977) reported large influx of water in the berry during the last period of rapid growth which is brought about by high $GA_3$ content in the berry during that phase. So high moisture content in the berries during lag phase (dry weight) in Dormex + $GA_3$ + CPPU treated plants can be attributed to the above fact. Retamales *et al.* (1993) reported that CPPU treatment increased berry weight more than $GA_3$ alone, with combined treatments giving the highest increase. The increase in final berry weight was due to the prolonged berry development period, increased cell division due to the action of CPPU and cell enlargement due to the action of $GA_3$.

Although, application of Dormex advanced bud burst by 30 days, the ripening was advanced by only 7 days. This is in contrast to the findings of Pandey (1989) where Dormex application advanced berry ripening by 16 days. Poni *et al.* (1990) reported that effects of dormex induced bud break hastening, became less marked during the course of berry development and maturity was unaffected by the treatment. Both $GA_3$ and CPPU prolonged berry growth period which was nullified by early bud burst by Dormex. Kim (1991) also reported delaying of berry maturation by 17 days with kinetin and $GA_3$. High level of inhibitor(s) has been found to be associated with lag phase of berry growth (Farmahan and Pandey, 1977). Exogenous application of ABA during lag phase of berry growth resulted in an increase in endogenous ABA and enhance sugar accumulation (Coombe, 1973). This indicates the necessity of lag phase for sugar accumulation which starts immediately after the end of lag phase. An absence of lag phase might have reduced the final TSS of the grape berries. But theTSS of the ripened berries of treated plants were at par or more than the control. Presence of lag phase in berry growth (dry wt.) justifies the importance of berry growth inhibition on quality of ripened berries. The slight reduction in TSS of D + CPPU treated berries may be due to dilution effect of berry growth. This can be explained by the poor ability of cytokinin to translocate photosynthate to growing fruits (Roubelakis and Kliewer, 1976).

In conclusion, a combination of Dormex, CPPU and $GA_3$ modified the berry growth pattern of Pusa Seedless grape. Although, the treatments Dormex + CPPU and Dormex + $GA_3$ + CPPU eliminated the lag phase of berry growth in terms of fresh weight, it was distinct in terms of dry weight. The prolongation of berry growth period by CPPU and $GA_3$ was nullified by early bud burst effect of Dormex. Further research is needed to find out the effect of these treatments applied at different stages of berry growth, on changes in the levels of endogenous hormones in the grape berries.

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