



# EFFECT OF FOLIAR APPLICATION OF BIO-STIMULANTS ON APPLE CV. ROYAL DELICIOUS

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## Abstract

Field experiments were conducted during 2017 and 2018 at Regional Horticultural Research & Training Station, Sharbo (Himachal Pradesh), to determine the response of bio stimulants application on quality parameters of apple fruit. The experiment was comprised of seven treatments viz., T<sub>1</sub>: Control (Untreated), T<sub>2</sub>: APPLIN @1.0ml/Lt, T<sub>3</sub>- APPLIN @ 1.25ml/Lt, T<sub>4</sub>- APPLIN @ 2.0 ml/Lt, T<sub>5</sub>- APPLIN @ 2.5 ml/Lt, T<sub>6</sub>- Standard 1- Energy 2000 @ 3.33ml/Lt (after fruit Set Stage), T<sub>7</sub>- Standard 2- Biozyme Fruit Plus @ 1.25 ml/Lt, laid out in randomized block design with four replications. The plants selected for the trials were uniform in size and vigor and also received uniform dose of fertilizers as per university recommendations and the plant protection measure was also similar in all the treatments. The data revealed that application of APPLIN @ 2.0 ml/Lt recorded significantly higher fruit length (72.90 mm), fruit breadth (77.64 mm), fruit weight (181.64 g), Total Soluble solids (13.03 B) and fruit colour (A<sup>++</sup>) over the foliar application of other treatments and control. However, acidity (0.34%) and L/D ratio (0.98) were observed maximum in foliar application of control T<sub>1</sub> and T<sub>7</sub> (S2), respectively. The application of APPLIN at the rate of 2 ml /liter at walnut stage was most effective in enhancement of fruit size, fruit shape, length/ diameter ratio and fruit colour in apple cultivar Royal Delicious.

**Key words:** Applin, Quality, Fruit weight, Acidity, Fruit set, Royal Delicious.

## Introduction

Apple is a main fruit crop of Himachal Pradesh and in recent years, it has emerged as the leading remunerative cash crop amongst fruit crops. It alone accounts for 49 percent of total area under fruit crops and 74 percent of the total fruit production. The area under apple has increased from 97438 hectares in 2008-09 to 112634 hectares on 2017-18 (Anonymous, 2019). The fruit crop contributes more than 3313 crore towards the gross domestic product. The apple production level has gradually touched to 368603 MT with 3.27 MT productivity in 2018-19 (Anonymous, 2019). The production of apple has been gradually increased but void of export quality fruit production, it is still a great concern for the farming community of this state to produce quality apple in coming years. In order to improve the quality of fruits to meet

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the export standards, the horticulture sector is therefore constantly seeking for new practices to integrate in the management of the cultivation systems. Bio-stimulants are considered among the most innovative and promising solutions to improve the quality of fruit crops. Bio-stimulants are defined as “any substance or micro-organism applied to plants with the aim to enhance nutrition efficiency, abiotic stress tolerance and/or crop quality traits, regardless of its nutrients content” (Du Jardin, 2015). According to the European Bio-stimulants Industry Council the benefits of bio-stimulants are, improving the efficiency of the plant’s metabolism to induce yield increases and enhanced crop quality, Increasing plant tolerance to and recovery from abiotic stresses, Facilitating nutrient assimilation, translocation and use, Enhancing quality attributes of produce, including sugar content, colour, fruit seeding, etc, Rendering water use more efficient, Enhancing soil fertility, particularly by

fostering the development of complementary soil micro-organisms. Unfortunately, very limited researches have been carried out regarding the use of bio-stimulants on fruit crops. Effect of bio-stimulants like APPLIN, Biozyme Fruit Plus and Energy 2000 (Standard) on fruit characteristics have to be studied in various fruit crops to assess the effect on quality parameters. Hence, the objective of the present study was to study the effect of foliar application of bio-stimulants on Size, Shape and Colour of apple fruit & Phyto-toxicity symptoms on apple *cv.* Royal Delicious.

## Materials and Methods

The present investigation was undertaken during the years 2016-17 and 2017-18 in the Regional Horticultural Research & Training Station of Dr. Y.S. Parmar UH&F Nauni Solan, Himachal Pradesh. The experiment was carried out with randomized block design with four replications considering stages of after fruit set stage and walnut stage of fruit development. The treatments consisted of T<sub>1</sub>: Untreated control, T<sub>2</sub>: APPLIN @1.0ml/Lt, T<sub>3</sub>: APPLIN @ 1.25ml/Lt, T<sub>4</sub>: APPLIN @ 2.0ml/Lt, T<sub>5</sub>: APPLIN @ 2.5ml/Lt T<sub>6</sub>: Standard 1- Energy 2000 @ 3.33ml/Lt (after fruit Set Stage), T<sub>7</sub>: Standard 2- Biozyme Fruit Plus @ 1.25 ml/Lt. all the treatments were applied as foliar sprays, at walnut stage and fruit set stage. The plants selected for the trials were uniform in size and vigor and also received uniform dose of fertilizers as per university recommendations and the plant protection measure was also similar in all the treatments. The fruit samples collected during September were washed and kept for analysis. Fruit length, breadth and L/D ratio were measured with vernier calipers and fruit weight was recorded in a sensitive weighing balance. Total soluble solids were measured with the help of refractometer and total acidity was estimated by using standard methods and procedures given by A.O.A.C., (1970). Ten fruits were selected randomly from each treatment and kept in normal environmental conditions and at the same time remaining five fruit samples were kept in room

temperature to determine the shelf life (days). The data obtained were tabulated and analyzed subjected to the Analysis of Variance (ANOVA) procedure of Statistical Analysis System (SAS).

## Results and Discussion

Foliar application of APPLIN along with two standard checks have shown a significant effect on the effect of on fruit length, fruit breadth, fruit weight, length/diameter ratio, total soluble solids (TSS) and acidity. It is evident from the data presented in table 1, that APPLIN, Energy 2000 and Bio-Zyme Fruit Plus has significant effect on fruit length, fruit breadth, fruit weight, fruit length/diameter ratio and total soluble solids (TSS) over the control during both the year of study. The maximum fruit length (72.90 mm) was recorded in treatment (T<sub>4</sub>) which was statistically at par with treatments (T<sub>3</sub> and T<sub>5</sub>) and the minimum fruit length (60.77 mm) was recorded in control (T<sub>1</sub>) during both the year of study. The fruit breadth was also recorded maximum (77.64 mm) in treatment (T<sub>4</sub>) which was statistically superior to other treatments in respect of fruit breadth.

The minimum fruit breadth (67.98 mm) was recorded in control (T<sub>1</sub>), which was statistically at par with the treatments of T<sub>2</sub> and T<sub>7</sub>. The enhancement of fruit length and breadth by the bio-stimulants application may be attributed to the profound effect of plant growth regulation substances produced by the effective microorganisms (bacteria, yeast and fungi) or In improving the availability and acquisition of nutrients from the soil which promoted the vegetative growth, Martin *et al.*, (1989) and Jagnow *et al.*, (1991) indicated that the bacteria produced adequate amount of IAA and cytokines, which increase the surface area per unit root length and cytokines, which increase the surface area per unit root length and hence enhanced the root hair branching with an eventual increase in acquisition of nutrients from the soil leads to improvement in fruit size. The present results are in harmony with those reported by Ghoneim (1999) and

**Table 1:** Effect of foliar application of APPLIN on different fruiting characteristics of apple *cv.* Royal Delicious.

Treatments	Fruit length (mm)			Fruit breadth (mm)			Fruit weight (g)			L/D ratio		
	2017	2018	Mean	2017	2018	Mean	2017	2018	Mean	2017	2018	Mean
T <sub>1</sub> Control	65.58	55.95	60.77	68.42	67.53	67.98	164.23	124.25	144.24	0.92	0.82	0.87
T <sub>2</sub>	70.82	56.26	63.54	70.23	68.27	69.25	167.12	128.25	147.69	1.03	0.83	0.93
T <sub>3</sub>	75.32	61.09	68.21	72.35	70.56	71.46	178.20	148.50	163.35	1.04	0.87	0.96
T <sub>4</sub>	80.54	65.25	72.90	77.70	77.57	77.64	184.40	178.87	181.64	1.03	0.84	0.94
T <sub>5</sub>	76.60	63.51	70.06	73.71	72.40	73.06	178.30	166.62	172.46	1.03	0.84	0.94
T <sub>6</sub> (S <sub>1</sub> )	74.60	60.96	67.78	71.39	70.53	70.96	175.80	141.25	158.53	1.04	0.84	0.94
T <sub>7</sub> (S <sub>2</sub> )	74.12	57.95	66.04	70.52	69.30	69.91	172.30	139.50	155.90	1.05	0.90	0.98
CD <sub>(0.05)</sub>	5.63	2.84	4.24	3.22	2.32	2.77	7.89	12.10	10.00	0.040	0.039	0.40

**Table 2:** Effect of foliar application of APPLIN on different fruiting characteristics of apple cv. Royal Delicious.

Treatments	Total soluble solids (TSS °B)			Acidity (%)			Colour*		
	2017	2018	Mean	2017	2018	Mean	2017	2018	Mean
T <sub>1</sub> Control	65.58	55.95	60.77	68.42	67.53	67.98	164.23	124.25	144.24
T <sub>2</sub>	70.82	56.26	63.54	70.23	68.27	69.25	167.12	128.25	147.69
T <sub>3</sub>	75.32	61.09	68.21	72.35	70.56	71.46	178.20	148.50	163.35
T <sub>4</sub>	80.54	65.25	72.90	77.70	77.57	77.64	184.40	178.87	181.64
T <sub>5</sub>	76.60	63.51	70.06	73.71	72.40	73.06	178.30	166.62	172.46
T <sub>6</sub> (S <sub>1</sub> )	74.60	60.96	67.78	71.39	70.53	70.96	175.80	141.25	158.53
T <sub>7</sub> (S <sub>2</sub> )	74.12	57.95	66.04	70.52	69.30	69.91	172.30	139.50	155.90
CD <sub>(0.05)</sub>	5.63	2.84	4.24	3.22	2.32	2.77	7.89	12.10	10.00

\*A<sup>+</sup>: 80-90% Red, A<sup>++</sup>: 90-100% Red

Eissa, (2002). During both the year of study, the highest fruit weight (181.64 g) was also recorded in Treatment (T<sub>4</sub>) which was statistically at par with treatment T<sub>5</sub>, where as it was lowest (144.24 g) in control (T<sub>1</sub>), which was statistical at par with T<sub>2</sub>. The length/diameter ratio was recorded maximum (0.98) in treatment T<sub>7</sub>, which was statistically at par with treatments T<sub>3</sub>, T<sub>4</sub>, T<sub>5</sub> and T<sub>6</sub>. It is apparent from the Table 2 that the highest total soluble solid (13.03°B) was recorded in T4 which was statistically at par with treatment T5, whereas lowest total soluble solids (11.89°B) was observed in control (T<sub>1</sub>). The effect on acidity was found to be significantly higher (0.34%) in treatment T<sub>1</sub> (Control). However, the minimum acidity (0.14%) was recorded in treatments T<sub>4</sub>, which was statistically at par with T<sub>5</sub> and T<sub>7</sub>. During the course of two years of study, the fruit colour development was also influenced by these treatments and highest red colour proportion was observed with treatments T<sub>4</sub> and T<sub>5</sub> respectively. All the studied parameters were found to be affected by the bio-stimulant treatments compared to the untreated trees, in both seasons. All the applications of bio-stimulant generally, improved fruit quality (*i.e.* fruit weight, fruit dimensions, TSS% and Total sugars%)

**Table 3:** Effect of foliar application of APPLIN on appearance of phyto-toxicity on apple cv. Royal Delicious.

	Phyto-toxicity on Fruits Surface		Effect on Fruits Drop		Phyto-toxicity on Foliage	
	2017	2018	2017	2018	2017	2018
T <sub>1</sub> Control	65.58	55.95	60.77	68.42	67.53	67.98
T <sub>2</sub>	70.82	56.26	63.54	70.23	68.27	69.25
T <sub>3</sub>	75.32	61.09	68.21	72.35	70.56	71.46
T <sub>4</sub>	80.54	65.25	72.90	77.70	77.57	77.64
T <sub>5</sub>	76.60	63.51	70.06	73.71	72.40	73.06
T <sub>6</sub> (S <sub>1</sub> )	74.60	60.96	67.78	71.39	70.53	70.96
T <sub>7</sub> (S <sub>2</sub> )	74.12	57.95	66.04	70.52	69.30	69.91

however firmness was not affected compared to the control in both seasons. These results reflect similar trends to those of plant growth and mineral content leaves as previously mentioned. Therefore, increase might be attributed to the increments on the amounts of metabolites synthesized by the plant which, in turn, accelerate plant growth and resulted in improving fruit quality parameters. These results can be explained as the bio-stimulant contains more than 60 selected strains of microorganisms as bacteria, yeast, actinomycetes and various and various

fungi. The high contents of minerals and vitamins as well as the cytokines contents in yeast might play a role in orientation and translocation of metabolites from leaves into the productive organs as recorded by Attala *et al.*, (2000). Also similar results were recorded by Eissa, (2003) and Dawa, (2000). Symptoms of phyto-toxicity were not observed (Table 3) on the fruit surface, leaf surface and initiation of fruit fall during the study period.

## Conclusions

Bio-stimulants play a very important role in fruit production by influencing various physiological processes. Results enumerated that the application of APPLIN along with two standard checks had a significant effect on n fruit length, fruit breadth, fruit weight, length/diameter ratio, total soluble solids (TSS) and acidity of apple cv. Royal Delicious. In the light of this situation foliar application of APPLIN at the walnut stage of fruit development @ 2ml/liter influence the fruit size, shape, acidity and colour development of Royal Delicious cv. of apple.

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