Effect of Promalin on Growth and Yield Parameters of Apple Cultivar "Royal Delicious" in Humid Subtemperate Zone of Himachal Pradesh, India

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Abstract: Quality is one of the important factors that determines the price and marketability of fruits, especially those which are intended for fresh consumption. For apples, quality includes shape, color, size, firmness, and "typiness". The influence of external factors such as climate, as well as internal factors such as genes and hormones, control these parameters. Based on the results of field evaluation under orchard condition, it can be concluded that the Promalin @ 60 ppm as foliar spray at full bloom stage on Apple cultivar "Royal Delicious" had significant influence on fruit size, shape, fruit yield and other yield contributing traits and had no phytotoxicity on Apple. Promalin at recommended dose @ 60 ppm and its double dose @ 90 ppm applied as foliar spray, had no phytotoxicity influence on Apple trees at all the intervals of observations

INTRODUCTION

Quality is one of the important factors that determines the price and marketability of fruits, especially those which are intended for fresh consumption. For apples, quality includes shape, color, size, firmness, and "typiness". The influence of external factors such as climate, as well as internal factors such as genes and hormones, control these parameters. Among these factors, we can't control external environment but manipulate genes and hormones pathway. However, manipulation of hormonal pathway and genes is time consuming process. Therefore, different plant growth regulators (PGRs) / Bio Regulators are used to increase the size and quality of fruit. PGRs are chemicals used to modify plant growth such as increasing branching, suppressing shoot growth, increasing return bloom, removing excess fruit, or altering fruit maturity.Application of plant growth regulators results in better output as it improves the internal physiology of developing fruits to improve fruit set, reduce fruit drop and to amend various physiological disorders in order to improve quality and yield.The result is the fruit enlargement by the increase of the cells numbers which are much bigger. On the other hand, GA4+7 affect at the number of the seeds, this is depended on the time of treatment and the dosage used. By the evolution from the full blooming period there is an increase of the number of seeds in the fruit (Green D. W., 1989). 6-Benziladenina is used to the apple as thinner and also to improve the size, color and above all the fruit quality (CFNP TAP Report, 2004). Benziladenina can be used solely and also accompanied by other growth regulators of plant. The most common mixture is Giberelina A4+7 (Accel or Promalin) (Lang G. et al. 1996). The application of Cytokines and Gibberellins solely and combined to the apples of the group Delicious right after the blooming period, can affect the shape of the fruit, increasing the ratio Length/Diameter (Williams M.W. and

Stahly E.A., 1969).In this investigation, we used Promalin and standardized of their dose for enhancing fruit size, shape, weight and fruit yield.

MATERIALS AND METHODS

An experiment was conducted at ICAR-IARI, Regional Station, Research Farm, Dhanda, Shimla to evaluate "Promalin" on Apple cultivar 'Royal Delicious' grafted on Pusa Apple Rootstock-101 for fruit size, shape and better yield. Experiment was laid out in randomized block design and replicated thrice. Promalin was applied in different concentrations viz., 10 ppm, 30 ppm, 60 ppm and 90 ppm along with Gibberellic Acid (100 ppm) at the 50% full king bloom stage. Water was sprayed in the untreated control. The required quantity of Promalin was diluted in 3 liters of water per tree. The spray solution was applied using high volume sprayer to ensure uniform wetting of the entire canopy area. Observations were recorded for fruit length (cm), fruit diameter (cm), L/D ratio, fruit weight (g) and fruit yield per tree (kg). Observations for phytotoxicity were taken at 0, 1, 3, 5, 7, 10, 15, 20, 25 and 30 days after foliar application for different parameters *viz.*, epinasty, hyponasty, yellowing, necrosis, leaf injury, vein clearing and stunting as per phytotoxicity scale (Watpade et al., 2021).

RESULTS AND DISCUSSION

Significant influence of different doses of Promalin was observed on fruit length, diameter, L/D ratio, fruit weight, yield and Russeting on fruit (**Table 1).** The fruit length increase 15.16 per cent over control in 60 ppm Promalin application followed by 30 ppmPromalin (11.20), GA 100 ppm (7.01) while only 2.97 per cent fruit length increase was calculated with application of 10 ppm Promalin which was at par with control. Fruit length varied from 6.07 cm to 6.99 cm in different treatments. Similar trend were also observed for fruit diameter, of which 9.99 per cent increase of diameter was recorded in 60 ppm Promalin than 8.05 per cent in 30 ppm over control.The length/diameter ratio of fruit ranged from 0.90 to 0.95. The maximum L/D ratio (0.95) were calculated in 60 ppm Promalin application, which 5.55 per cent increase over

control followed by 30 ppm (0.93) and 10 ppm (0.92). In similar studies promalin application have been appeared to increase fruit size and the fruit L/D proportion (Greene, 2003, Jindal et al., 2004 andBhat et al., 2022).Fruit weight varied from 155.93 g to 238.78 g across the treatments. Foliar application of 60 ppm Promalin at full bloom stage enhanced 53.13 per cent fruit weight than 30 ppm (43.15 %), 90 ppm (36.84 %) and GA 100 ppm (25.42 %) over control.

Total fruit yield varied from 29.38 kg to 40.57 kg per tree, of which maximum fruit yield (40.57 kg) was obtained by application of 60 ppm Promalin followed by 30 ppm (38.18 kg), 90 ppm (35.38 kg) and GA 100 ppm (33.19 kg) while minimum fruit yield was recorded in control (29.38 kg) followed by 10 ppm Promalin (32.91 kg). Enhancement of fruit yield and its contributing traits after application of different doses of Promalin over control indicating their effectiveness on apple crop. Incensement in fruit length and diameter might be due to an increased rate of cell division in the young fruit. BurakandBuyukyilmaz (1997) also found that promalin treatments increased fruit size, fruit length, L/D ratio over control.

Russetting per cent on apple was significantly decreased over control after application of Promalin. 83.40 per cent decrease in russeting was recorded when Promalin @ 60 ppm was applied as foliar spray at full bloom stage over control followed by 30 ppm, 10 ppm and 90 ppm which was statistically at par with each other while, only 27.26 per cent decrease in russeting was recorded in GA @ 100 ppm over control. According Green 1989, Gibberellins A4+7 are the main causers of parthenocarpy. As it is said that the Promalin is a mixture compound of these Gibberellins, it was observed and studied the effect of the hormonal preparation to the reduction of the seeds at the apple fruit, for both cultivars studied. Amy Irish-Brown, and Phil Schwallier 2017) observed increase cell division, increase fruit weight, increase apple typiness, increase fruit set and start the thinning process. PirroIcka et.al (2009)also got the same result after studying the effect of promalin on fruit shape and quality of Golden and Red Delicious cultivars at the region of korça.

Table 1: Effect of Promalin on Yield and its contributing Traits of Apple cv. Royal Delicious

Sl. No.	Treatments	Fruit Length (cm)	Fruit Diameter (cm)	L/D Ratio	Fruit Weight (g)	Fruit Yield / Tree	Russetting on fruit ** (%)
1.	Promalin (10 ppm)	6.25 (2.97)	6.82 (1.64)	0.92 (2.22)	170.01 (9.03)	32.91 (12.01)	20.05 (69.80)
2.	Promalin (30 ppm)	6.75 (11.20)	7.25 (8.05)	0.93 (3.33)	225.03 (43.15)	38.18 (29.95)	14.37 (76.28)
3.	Promalin (60 ppm)	6.99 (15.16)	7.38 (9.99)	0.95 (5.55)	238.78 (53.13)	40.57 (38.09)	10.05 (83.40)
4.	Promalin (90 ppm)	6.41 (5.60)	6.98 (4.02)	0.92 (2.22)	213.38 (36.84)	35.38 (20.42)	28.13 (53.55)
5.	Gibberellic Acid (100 ppm)	6.50 (7.01)	7.20 (7.30)	0.90 (1.11)	195.57 (25.42)	33.19 (12.96)	44.05 (27.26)
6.	Control (0.00)	6.07 (0.00)	6.71 (0.00)	0.90 (0.00)	155.93 (0.00)	29.38 (0.00)	60.56 (100.00)
L.S.D. (0.05)		0.11	0.13	0.02	5.71	2.23	15.04

* Data in parenthesis is per cent increase over control, **Data in parenthesis is per cent decrease over control

Table 2: Effect of Promalin on Phytotoxicity of Apple cv. Royal Delicious

Sl. No.	Treatments	Epinasty	Hyponasty	Yellowing	Necrosis	Leaf injury	Vein clearing	Stunting
1.	Promalin (10 ppm)	0	0	0	0	0	0	0
2.	Promalin (30 ppm)	0	0	0	0	0	0	0
3.	Promalin (60 ppm)	0	0	0	0	0	0	0
4.	Promalin (90 ppm)	0	0	0	0	0	0	0
5.	Gibberellic Acid (100 ppm)	0	0	0	0	0	0	0
6.	Control (0.00)	0	0	0	0	0	0	0

Phytotoxicity symptoms were observed at intervals of 0, 1, 3, 5, 7, 10, 15, 20, 25 and 30 days after respective application of Promalin foliar spray.

The application of different doses (foliar spray) of Promalin had no phytotoxicity influence on apple trees at all the intervals of observations (Table 2).

CONCLUSION

Based on the results of field evaluation under field condition, it can be concluded that the Promalin @ 60 ppm as foliar spray at full bloom stage on apple had significant influence on fruit size, shape, fruit yield and other yield contributing traits and had no phytotoxicity on Apple. Promalin at i.e. at different concentrations including at highest dose i.e. 90 ppm applied as foliar spray, had no phytotoxicity influence on apple trees at all the intervals of observations.

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