



International Journal of Research in Agronomy

E-ISSN: 2618-0618

P-ISSN: 2618-060X

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www.agronomyjournals.com

2024; 7(1): 354-357

Received: 25-11-2023

Accepted: 26-12-2023

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Effect of foliar application of Ambition: A biostimulant on yield and quality of apple

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DOI: <https://doi.org/10.33545/2618060X.2024.v7.i1e.238>

Abstract

Bio stimulants like amino acids and filmic acids, aid in the penetration of nutrients into the plant system and increase the antioxidant enzyme activity which provides stress tolerance to plant and enhances crop performance. To evaluate the potential effectiveness of foliar application of Ambition- a biostimulant in apple, an experiment was conducted at Regional Horticultural Research & Training Station, Sharbo (Kinnaur, Himachal Pradesh), to determine the response of Ambition- a biostimulant on yield and quality of apple cv. Super Chief. Ambition - a biostimulant at various stages influenced physical and chemical parameters of Super Chief apple. Higher doses of Ambition foliar application i.e. Ambition @400ml/100L water and 200ml/100L water per plant, At initiation of pink bud stage, 15 days after first application, 30 days after second application, 30 days after third application resulted in improvement in Yield, fruiting and quality parameters of apple.

Keywords: Ambition-a biostimulant, quality, percent fruit set, yield

Introduction

Apple (*Malus x domestica* Borkh.) is viewed as a major fruit crops in temperate regions of the world, with a considerable area under cultivation. Himachal Pradesh is well known for cultivating temperate horticultural crops and has earned recognition as the leading apple-producing region in India. Apple is grown in an area of 115.16 thousand hectares in Himachal Pradesh, producing 672.34 thousand tones (2022-23) (Anonymous, 2023) [1]. Apple cultivation in high-mountain districts of HP holds significant potential for generating income and employment. Despite this, its productivity is not up to the expected standard. Several factors like inadequate pollinizer proportion, reduction in natural population of pollinating agents, inadequate winter chilling, poor nutrient management, occurrence of biotic and abiotic stresses etc. have been attributed to low productivity of apple. Also the horticultural sector is facing concurrent challenges to boost crop productivity in order to feed the increasing global population and concomitantly to minimize the excessive use of agrochemicals (fertilizers and pesticides) which can negatively impact human health and the ecosystems.

Developing new technologies that can improve the overall sustainability of production systems together with an enhancement of quality and safety of the produce is a constant quest for the fruit crop industry. For the past decade, plant bio stimulants such as humic and fulvic acids, protein hydrolysates, seaweed extracts (Battacharyya *et al.*, 2015; Canellas *et al.*, 2015; Colla *et al.*, 2017) [5, 6, 7], have become a novel and promising production tool that can enhance the efficiency of horticultural inputs (i.e. irrigation water and fertilizers), to promote crop tolerance toward different abiotic stressors (i.e. drought, salinity, extreme temperature and radiation) and to enhance the final quality of produce. Natural substances like humic acids, protein hydrolysates, seaweeds extracts etc., can represent a valuable tool to conquer nutrient deficiency in different crops by enhancing plant resilience and also by improving nutrient uptake and assimilation (De Pascale *et al.*, 2017; Souri and Hatamian, 2019) [17, 21].

Plant bio stimulants have been extensively researched on their mode of action and agronomical performance, but their effectiveness on yield and quality of fruit crops are relatively scarce. Hence, present research was conducted with the objective of studying the effect of Ambition-Biostimulant foliar application on yield and fruit quality of the apple.

Materials and Methods

The research was conducted during the year 2022 in experimental orchard of Regional Horticultural Research & Training Station, Sharbo (Kinnaur, Himachal Pradesh) to study the effect of Ambition-Biostimulant foliar application on yield and fruit quality of the apple, planted in 2008 with Super Chief cultivar grafted on seedling rootstock, at planting distance of 5x5 m. Ambition is advanced crop supplement containing amino acid and fulvic acid with the view to enhancing crop efficiency. It helps crops reach their true potential by managing nutrient efficiency, improving plant defense mechanisms, and enhancing crop performance.

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 treatments were consisted of T₁: Control (Untreated), T₂: Ambition @ 100 ml/100L water per plant (At initiation of pink bud stage, 15 days after first application, 30 days after second application, 30 days after third application), T₃: Ambition @ 150 ml/100L water per plant (At initiation of pink bud stage, 15 days after first application, 30 days after second application, 30 days after third application), T₄: Ambition @ 200 ml/100l water per plant (At initiation of pink bud stage, 15 days after first application, 30 days after second application, 30 days after third application), T₅: Ambition @ 400ml/100lwater per plant (At initiation of pink bud stage, 15 days after first application, 30 days after second application, 30 days after third application). The experiment was laid out in a randomized block design with five replicates. Fruit samples collected during mid- August were weighed, washed and kept for analysis.

A sample of randomly picked ten fruits per treatment was harvested at commercial maturity for determining of quality attributes. Fruit quality parameters fresh weight of fruit, Total Soluble Solids (TSS), Titratable Acidity (TA), firmness, Juice PH were immediately assayed after harvest with specific analytical methods. The weight of the fruits was recorded on a sensitive balance. The TSS content was directly read on Zeis's hand refractometer by putting a drop of fruit juice on prism and reading as Brix° at 20°C (A.O.A.C., 1980)^[2]. The acidity of the collected fruits was determined by diluting a known amount of fruit juice and titrating against 0.1 N sodium hydroxide solution, using phenolphthalein as an indicator, and expressed as percent of malic acid. Other chemical analyzes of fruits were determined according to standard methods. Firmness of flesh was determined by a pressure tester (Magness-Taylor) which recorded the pressure necessary for the plunger to penetrate the flesh. Apples crop load was harvested during the month of August from each tree and the yield was recorded as kg/tree. Color percentage is calculated on the basis of visible fruit skin color. The obtained data were tabulated and analyzed under analysis of variance (ANOVA) procedure of statistical analysis system (SAS).

Result and Discussions

Yield and fruiting characteristics: The obtained results showed that spraying Ambition was effective in improving yield and fruiting attributes of apple. The data in table 1 depicts significant differences among various treatments on yield parameters of apple fruit. The highest marketable yield (48.89 Kg/tree) was also recorded in Treatment (T₅) which was significantly similar to Treatment T₄ (47.14 Kg/tree) in the study, whereas it was lowest (31.32 Kg/tree) in control (T₁).

Sebastian Soppelsa *et al.*, 2020 while studying use of bio stimulants for organic apple production stated that plant bio stimulants are known to modulate plant molecular and physiological processes that boost plant growth, productivity, quality and improve the impact of abiotic stressors. Authors Ertani *et al.*, 2015^[10] on hot pepper reported an increment of plant productivity as the result of a stimulation mechanism of the plant primary metabolism triggered by signaling molecules (peptides, oligopeptides, and free amino acids) contained in the hydrolysate. Furthermore, studies on the use of biostimulant products in the fruit production industry are still limited as compared to other agricultural crops. It is evident from the table 1 that, higher dose of ambition (T₅) showed highest fruit set percentage of 78.73% which was statistically at par with T₄ (76.75%) compared to control (68.41%). T₅ also had more number of fruits per tree (316.40) and fruit weight (161.07g), minimum number of fruits and fruit weight were recorded in control i.e. 249.80 and 132.58g, respectively. Yield had a significant effect on fruit weight. Biostimulants like amino acid and fulvic acid facilitates the nutrient penetration into the plant system and boosts the antioxidants enzyme activity which provides stress tolerance to plant. It helps crops reach their true potential by managing nutrient efficiency, improving plant defense mechanisms, and enhancing crop performance. Our results in terms of yield/tree were in accordance with authors Awad *et al.*, (2007)^[4] who reported that foliar application of amino acids caused an enhancement in yield and its components on potato. The general positive effects of amino acid foliar spray applications could be attributed to enhanced pollen tube ovule penetration and delayed ovule senescence which increases fruit set and yield (Arabloo *et al.*, 2017)^[3].

Quality Characteristics: Fruit firmness increased after foliar spray with ambition and had significant differences between various treatments were observed. It was recorded maximum in T₅ (11.98 Kg cm²) followed by T₄ (11.31 Kg cm²) and was recorded minimum in T₁ control (8.65 Kg cm²). Similar results for fruit firmness were obtained by Arabloo *et al.*, 2017^[3] on Golden Delicious and Granny Smith apple cultivars as well as by Koksai *et al.*, 1999^[14] on pear who have reported there is a positive influence of foliar spray of amino acid on fruit firmness. Among the various treatments pH of juice ranged from 3.43 to 4.30 (T₁ and T₅, respectively). Exogenous application of amino acids have been reported to improve the growth, yield and biochemical quality of grapes (Khan *et al.*, 2012)^[13], apples (Arabloo *et al.*, 2017)^[3] and pears (Fayek *et al.*, 2011)^[11]. Amino acids are considered as precursors and constituents of proteins which are necessary for promoting cell growth. They contain both acid and basic groups and act as buffers, which led to maintain favorable pH value within the plant cell (Davies, 1982)^[8]. Amino acids can directly or indirectly affect the physiological activities in plant growth and development. Total soluble solids was noticed maximum in T₅ (13.92 °B) followed by T₄ (13.65 °B), however T₂ (11.48 °B) recorded minimum TSS. According to the available literature, bio stimulants can have different effect on final sugar accumulation in fruits. Protein hydrolysate-based substances were found able to enhance final sugar content in hot pepper and tomato (Ertani *et al.*, 2015; Rouphael *et al.*, 2017)^[10, 17]. Differently, seaweed extracts did not changed or slightly reduced final Brix value in strawberry fruits (Roussos *et al.*, 2009)^[18] and grapevine berries

(Frioni *et al.*, 2018) [12]. The data on acidity revealed that, T₅ recorded minimum acidity percentage (0.13), which was statistically at par with T₄ (0.17), maximum acidity percentage (0.39) was recorded in control (T₁). The obtained outcomes were also similar to the finding of Soppelsa *et al.* (2018) [19] who observed same effect of the bio stimulants on primary apple quality traits (FF, TSS, and TA). Fruit colour index was slightly influenced by various treatments and it ranged from 90-95 to 95-100) as depicted in table 2. These results are in close conformity

with the results of Malaguti *et al.*, (2002) [15] on apple “Gala” and Frioni *et al.* (2018) [12] on red grapevine cultivars evaluated in different cultivation areas. The elevated final red color of apples might be endorsed to a modulation of the metabolism of plant endogenous growth regulators (mainly cytochins and abscisic acid) obtained with the application of the biostimulant substances (Wally *et al.*, 2013) [20], leading to an induction of anthocyanin biosynthesis and accumulation in fruit skin prior to harvest.

Table 1: Effect of foliar application of AMBITION on different physical and chemical parameters of apple cv. Super Chief

Treatments	Percent fruit set (%)	Number of fruits per tree	Average Fruit weight (g)	Yield Kg/Tree	Fruit Firmness (Kg cm ²)	Juice pH	Total Soluble Solids (TSS °B)	Acidity (%)	Colour Index (%)
T ₁ Control	68.41	249.80	132.58	31.32	8.65	3.43	11.79	0.39	90-95
T ₂	70.64	283.38	140.32	38.36	8.72	3.44	11.48	0.24	90-95
T ₃	71.97	292.93	145.74	41.45	9.08	3.80	12.39	0.22	95-100
T ₄	76.75	307.00	154.51	47.14	11.31	4.19	13.65	0.17	95-100
T ₅	78.73	316.40	161.07	48.89	11.98	4.30	13.92	0.13	95-100
CD(0.05)	3.15	4.13	4.10	5.39	0.68	0.35	0.39	0.08	-----

Conclusion

Any substance or microorganism applied to plants with the aim to enhance nutrition efficiency, abiotic stress tolerance and/or crop quality traits, regardless of its nutrients content is Biostimulant (Du Jardin, 2015) [9]. Ambition-a biostimulant is advanced crop supplement containing amino acid and filmic acid enhances crop efficiency. As biostimulant products are not widely studied in the fruit production industry, unlike other agricultural crops. From the present study it was concluded that foliar application of Ambition at various stages influenced physical and chemical parameters of Super Chief apple. Higher doses of Ambition foliar application i.e. Ambition @ 400ml/100L water and 200ml/100L water per plant, At initiation of pink bud stage, 15 days after first application, 30 days after second application, 30 days after third application resulted in improvement in Yield, fruiting and quality parameters of apple.

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