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Efficacy of boron and molybdenum on growth, yield and quality parameters of Cauliflower (*Brassica oleracea var. botrytis* L.)

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Abstract
The investigation was carried out on cauliflower cv. 'Pusa Snowball-16' at Agricultural Research Farm in the Department of Horticulture, School of Agriculture, Suresh Gyan Vihar University, Jaipur (Rajasthan) during rabi season of 2024-25. The experiment was laid out in Factorial Randomized Block Design with three replications which comprises of sixteen treatment combinations included four different levels of Boric acid (0, 0.1, 0.5 and 1.0 %) and four levels of Ammonium molybdate (0, 0.1, 0.2 and 0.5 %) and treatments were replicated three times. transplanting was done in mid-October by following 60 cm row to row and 45 cm plant to plant spacing.The various concentrations of boric acid and ammonium molybdatehad significant effect on various vegetative growth, yield and quality parameters and the maximum (45.41 cm) plant height, (16.13) leaves per plant, longest leaf (32.02 cm) and stalk length (33.80 cm, maximum (28.56 cm) width of largest leaf, minimum (61.48 days) for 50% curd initiation and (70.75 days) for 50% curd maturity, maximum (18.66 cm) diameter and (9.12 cm) curd length heaviest (993.14 g) fresh weight and highest (36.05 t/ha) marketable yield of curds, maximum (9.28 ° Brix) TSS and (46.07 mg/100 g) vitamin-C content were recorded under boric acid @ 0.5 % + ammonium molybdate @ 0.2 % treatment. Results further indicated that the maximum net return (₹. 1,99,349.50/ha) and the highest B: C ratio (2.72) of cauliflower production was recorded under boric acid @ 0.5 % + ammonium molybdate @ 0.2 % treatment followed by (₹. 1,75,790.76/ha) with (2.52) B:C ratio under boric acid @ 0.5 % + ammonium molybdate @ 0.1 % treatment. Whereas, Whereas, the minimum net return (₹. 56,684.55 /ha) and lowest B: C ratio (1.50) was recorded in control.

Keywords: Cauliflower, Boric acid, Ammonium molybdate

Introduction
Cauliflower (*Brassica oleracea var. botrytis* L.) is an important member of the family *Brassicaceae* and is often described as the "Aristocrat of Cole crops." India is currently the world's largest producer of cauliflower, followed by China. Other major producing countries include France, Italy, Spain, and Poland. In India, cauliflower is cultivated over an area of 0.48 million hectares, producing 9.53 million metric tonnes, with a productivity of 19.6 metric tonnes per hectare (Anonymous, 2024) [2]. West Bengal is the leading producer in India, followed by states such as Uttarakhand, Uttar Pradesh, Himachal Pradesh, Haryana, Rajasthan, Bihar, Gujarat, Maharashtra, Odisha, and Karnataka (Anonymous, 2024) [2]. Cauliflower can be used in numerous culinary applications, such as making as a soup, curry, or roasted vegetable. It can be eaten raw, steamed, grilled, baked, or fried, and is highly nutritious, containing fiber, vitamins, and antioxidants that support digestion and heart health.
Cauliflower thrives in well-drained soils with good fertility. However, due to excessive cropping and nutrient depletion, many micronutrients become deficient, adversely affecting plant growth and yield (Joshi, 1997) [10]. Among the micronutrients, boronandmolybdenum deficiencies are particularly common and detrimental in cauliflower production.
Boron deficiency typically causes browning of the curd, while molybdenum deficiency leads to the formation of "whiptail"—a condition in which the midrib of the leaf grows abnormally while the leaf blade remains underdeveloped. These disorders not only render the curds unfit for

human consumption but also significantly reduce yield (Singh and Thakur, 1991) [27]. Molybdenum plays a crucial role in the functioning of the enzyme nitrate reductase, which is responsible for the reduction of nitrate to nitrite during nitrogen assimilation. It is absorbed by plants in the form of the MoO_4^{2-} ion. Molybdenum is the only micronutrient that is mobile within the plant, so deficiency symptoms usually appear first on older and middle leaves before progressing to newer growth. Symptoms include chlorosis, cupping of leaves, and eventual collapse of the growing point. In severe cases, malformed leaves may consist primarily of a prominent midrib without proper lamina development, a condition known as whiptail (Singh and Thakur, 1991) [27].

Molybdenum is an important micronutrient for proper growth and development. The nitrate reductase enzyme, which converts nitrate to nitrite, the first step in nitrogen absorption into proteins, is connected to its metabolic role in plants. (Marschner *et al.* 1995; Bambara, 2010) [18, 3]. It also participates as an element is a nitrogenase cofactor, which is involved in biological nitrogen fixation and its deficit inhibits nodulation and nitrogen fixation. (Bambara, 2010) [3]. Elkhatib (2009) [5] and Chahal and Chahal (1991) [4] reported that foliar molybdenum treatments enhanced plant development by stimulating nodulation and biological nitrogen fixing. It is a necessary component of the plant's nitrate reductase enzyme. It's found in chloroplast envelops of leaves. Cauliflower probably suffers from a lack of molybdenum, and the effects can be severe. When a When a young cauliflower plant lacks molybdenum, it turns chlorotic and white, especially towards the leaf tips. They gradually get cupped and wither. The developing point collapses when the leaf dies. The lamina of new evolving leaves on older plants is uneven in shape, usually consisting of just a wide naked midrib, thus the popular term "whiptail." In a field trial, molybdenum (80 or 160 g/ha) spraying enhanced cauliflower production by 7-8 per cent above the control. (Joggi and Dixit, 1995) [9]. Hunashikatti *et al.* (2000) [8] With a good level of ascorbic acid (49.12 mg/100 g), a combined dose of 25 kg sulphur and 1 kg of molybdenum /ha yielded the highest yield. Molybdenum deficiency shows itself in young plants with chlorosis of the leaf tips, which develops to the entire leaf turning white. As a result, the leaf blade fails to grow normally, and only the midrib regions of the leaf develop, giving the leaves a sword-like look and causing the whiptail symptom. Furthermore, the amount of boron and molybdenum in the soil is determined by soil type, soil response, and the level of deficiency (Lal, 1993) [16]. Application of micro nutrients especially, Boron and Molybdenum are required for healthy curd development in cauliflower and also affects seed production as well. However, necessary information regarding the optimum dose of micronutrients, particularly boron and molybdenum affecting the yield and quality of cauliflower under semi-arid conditions of Rajasthan are scanty. The available information regarding the impact of micronutrient (boron and molybdenum) application on cauliflower crop is scanty. Keeping this in view, the present investigation was undertaken to increase the productivity to improve the livelihood of farmers.

Materials and Methods

The present investigation was carried out at Agricultural Research Farm in the Department of Horticulture, School of Agriculture, Jaipur (Rajasthan) during *rabi* season of 2024-25. The geographical coordinates are 26°51' North latitude, 75°47' East longitudes and at altitudes of 390 m above mean sea level. The climate of study place is semi-arid characterized by aridity of the atmosphere and extremity of temperature both in summer (48.5 °C) and winter (-1 °C) and soil was sandy-loam with 7.2 pH. The experiment was laid out in Factorial Randomized Block Design with three replications which comprises of sixteen treatment combinations included four different levels of Boric acid (0, 0.1, 0.5 and 1.0 %) and four levels of Ammonium molybdate (0, 0.1, 0.2 and 0.5 %) and treatments were replicated three times. The experiment was carried on cauliflower cv. 'Pusa Snowball - 16'planted in mid-October by following 60 cm row to row and 45 cm plant to plant spacing. The crop was irrigated weekly intervals and intercultural operations were done regularly as per the package and practices. The crop was foliar sprayed with boric acid and zinc sulphate as per specified in treatments at 30 days after transplanting. All data were recorded from five randomly selected and tagged plants throughout the investigation and their mean value calculated and statistically analyzed by OPSTAT software (Sheoran *et al.*, 1998) [26].

Results and discussion

1. Growth Parameters

The foliar application of different concentration of boric acid and ammonium molybdate had significant impact and remarkable increase in growth of cauliflower. The significant increase in plant height was observed by all treatment combinations of the exogenous application of various concentrations of boric acid and ammonium molybdate. Amongst the treatment, the tallest (40.34 cm) plant height, maximum (13.67) leaves per plant, longest (25.74 cm) leaf, (22.26 cm) width of largest leaf and longest (26.59 cm) stalk length were recorded under boric acid @ 0.5% treatment at harvesting stage (Table 1). Boron plays an important role in activation of cell division and cell elongation. Therefore, boron enhances the number of metabolites necessary for building plant organs, consequently the vegetative growth of plants increased (Marschner, 1995 and Alkharpotly *et al.*, 2018) [18, 1]. The tallest (41.60 cm) plant height, maximum (14.28) leaves per plant, longest leaf (32.02 cm), (23.85 cm) leaf width and longest (29.45 cm) stalk length were observed under ammonium molybdate @ 0.2% treatment (Table 1). These attributes might be due to Molybdenum (Mo) is an essential micronutrient for plant as it directly related to metabolic function of nitrogen in the plant through nitrate reductase enzyme that reduces the nitrate to nitrite (Bambara *et al.*, 2010) [3]. Molybdenum stimulates nodulation and biological nitrogen fixation, thus improving the plant growth (Elkhatib, 2009) [5]. These results are in close conformity with the findings of Meena (2019) [20] and Mahmud *et al.* (2021) [17]. In case of interaction effect, the tallest (45.41 cm) plant height, maximum (16.13) leaves per plant, longest leaf (32.02 cm), width of largest leaf (28.56 cm) and longest stalk length (16.09 cm) were observed at harvesting stage in plants sprayed with boric acid @ 0.5% + ammonium molybdate @ 0.2% and had significant effect over control (Table 1). The increase in growth characters might be due to the result of availability of required quantity of essential plant nutrients at various growth stages leading to hastening the metabolic processes of plant and sugar metabolism, translocation of solutes and protein synthesis through foliar spray of micronutrients (B and Mo) and consequently they improved different plant organs and also entire plant. These results are close conformity with findings of Ranjan *et al.* (2020) [12]; Kumar *et al.* (2021) [14] and Hasan *et al.* (2025) [6] in cauliflower.

2. Yield Attributing Parameters

It is apparent from the data presented in Table 2 revealed that the minimum (65.11 days) for 50% curd initiation and (75.89

days) for 50% curd maturity were taken under plants sprayed with boric acid @ 0.5% treatment followed by (65.32 days) and (76.38 days) under plants sprayed with boric acid @ 1.0 % treatment, respectively. Both treatments were performed statistically at par and had significant effect over control and boric acid @ 0.2% treatment. This might be due to boron acts as the key element for increasing the translocation of carbohydrates from the site of formation to reproductive tissues in curd in the cauliflower, whereas, molybdenum promoted the photosynthetic activities and also increase the metabolic process. Such significantly responses of micronutrients have also been recorded by Singh *et al.* in broccoli.

The minimum (64.22 days) for 50 % curd initiation and (75.89 days) for curd maturity were taken under foliar spray of ammonium molybdate @ 0.2 % treatment followed by (64.34 days) and (76.38 days) under ammonium molybdate @ 0.5 % treatment, respectively and both treatments were statistically at par. This might be due to the positive role played by the regulating micronutrients in the balanced absorption of nutrients might improve physiological activities, which resulted in the endogenous growth hormone synthesis responsible for early curd formation in plants. The present results are in agreement with the findings of Hassan *et al*. (2013) [7] in broccoli and Singh *et al*. in cauliflower.

In combinations of boric acid and ammonium molybdate significantly reduced the number of days for curd initiation and curd maturity in cauliflower. The treatment boric acid @ 0.5% + ammonium molybdate @ 0.2 % took the minimum (61.48 days) for 50% curd initiation followed by (62.54 days) under boric acid @ 1.0 % + ammonium molybdate @ 0.5 % treatment, whereas, the minimum (70.75 days) took for 50% curd maturity under boric acid @ 0.5% + ammonium molybdate @ 0.2 % treatment (Table 2). It might be due to cumulative effect of boric acid and ammonium molybdate application that attributed to enhanced photosynthesis activity and increased production and accumulation of carbohydrates and favorable effect. These results are accordance to Singh *et al*. and Meena *et al.* in cauliflower.

The maximum (17.10 cm) diameter and longest (8.33 cm) length of curd were recorded under boric acid @ 0.5 % followed by (16.98 cm) and (8.29 cm) under plants sprayed with boric acid @ 1.0 % treatment, respectively. Both treatments were observed statistically at par (Table 2). Increase in size with spraying of boric acid which provides the boron to the plant, might have regulated the cell wall permeability, thereby allowing more mobilization of water in plants attributing to larger curd size. These results are in close conformity with findings of Meena (2019) [20]. Ammonium molybdate also significantly increased the maximum (17.28 cm) curd diameter and (16.90 cm) curd length under ammonium molybdate @ 0.2 % treatment followed by (8.42 cm) and (8.24 cm) under ammonium molybdate @ 0.5 % treatment, respectively. Both treatments were statistically at par (Table 2). This might be due to the positive role played by the molybdenum in the balanced absorption of nutrients might improve physiological activities that increased the curd diameter and length (Kumar *et al*., 2012 and Singh *et al.*, 2017) [13, 29] in cauliflower.

The data presented in Table 2 further revealed that the interaction effect of boric acid and ammonium molybdate showed significant effect on curd diameter and length characters. The maximum (18.66 cm) diameter curd and longest (9.12 cm) curd were recorded under plants treated with boric acid @ 0.5 % + ammonium molybdate @ 0.2 % treatment. The interaction effect of boric acid @ 0.5 % + ammonium molybdate @ 0.2 % treatment showed the significant difference over other treatments and control. This may be due to the fact that both boron and molybdenum work synergistically and helps in growth of meristematic tissues growth which ultimately increases the length and diameter of curds. These findings are in line with earlier reports of Ranjan *et al*. (2020) [20]; Kumar *et al*. (2021) [14]; Kohar *et al.* (2023) [12] and Hasan *et al.* (2025) [6] in cauliflower.

3. Yield Parameters

The data pertaining to marketable yield of tubers is presented in Table 2 revealed that among the different concentrations of boric acid treatments, the heaviest (835.58 g) fresh weight of curd, maximum marketable yield of curds (30.58 t/ha) were recorded under foliar spray of boric acid @ 0.5 % treatment. Increase in the marketable curd yield might be due to boron micronutrient which play an important role in translocation of carbohydrates auxin synthesis to the sink and increased in pollen viability and fertilization that increases yield. An increase in curd weight due boron application that appear to have indirect role hastening the process of cell division and cell elongation as well as increase in curd size. These results are in accordance with the findings of Meena *et al*. (2018) [19] in cauliflower. In individual foliar sprayed plants with ammonium molybdate, the heaviest (818.18 g) fresh weight of curd, maximum marketable yield (40.09 kg/plot) and (29.70 t/ha) of cauliflower curd were recorded under ammonium molybdate @ 0.2 % treatment (Table 2). Increase in curd yield was due to promotive effects of molybdenum on vegetative growth enhanced curd yield which ultimately lead to more photosynthesis activities while, application of boron, enhanced carbohydrates, nitrogen metabolism of the pectic substances, as well as enhance the water metabolism and water relation in plants. These findings corroborate with the results reported by Ningawale (2016) [22]. Increase in growth attributes might be due to the fact that besides the role of molybdenum in chlorophyll formation, it also influenced cell division, meristematic activity of tissues, and expansion of cell and formation of cell wall. Similar results were also reported by Kanwar *et al.* (2019) [11] and Mahmud *et al.* (2021) [17].

The combined effect of boric acid and ammonium molybdate played significant role and produced the heaviest (993.14 g) fresh weight and (36.05 t/ha) marketable yield of curds under boric acid @ 0.5 % + ammonium molybdate @ 0.2 % treatment (Table 2). It might be due to synergistic effect boric acid and ammonium molybdate applied together. It may be attributed to enhanced photosynthesis activity and increased production and accumulation of carbohydrates and favorable effect on curds, which increased the size of curds by division and elongation of cell. These results are in agreement with the findings of Kohar*et al.* (2023) [12]; Sharma *et al.* (2023) [25] and Hasan *et al.* (2025) [6] in cauliflower.

4. Quality Parameters

The different concentrations of boric acid had non-significant effect on total soluble solids. The minimum (0.39 %) reducing sugar and (3.76 %) non-reducing sugar were recorded under ammonium molybdate @ 0.2 % treatment. While, the maximum (4.15 %) total sugar content was recorded under ammonium molybdate @ 0.2 % treatment followed by (4.54 %) in ammonium molybdate @ 0.5 % treatment (Table 3). Both treatments were observed statistically at par. The maximum (42.44 mg/100 g) vitamin-C was recorded under boric acid @ 0.5 % treatment followed by (40.93 mg/100 g) and (40.92

mg/100 g) vitamin-C content under boric acid @ 0.2 % and boric acid @ 1.0 % treatments, respectively (Table 3). This might be due to boron micronutrient which play an important role in translocation of carbohydrates auxin synthesis and stimulating the biochemical activities in cauliflower curds. These results are in accordance with the findings of Moklikar *et al*. (2015); Young *et al*. (2015) [21, 31].

In foliar spray of ammonium molybdate, the minimum (0.39 %) reducing sugar and (3.76 %) non-reducing sugar were recorded under ammonium molybdate @ 0.2 % treatment (Table 3). While, the maximum (43.48 mg/100 g) vitamin-C content was recorded under ammonium molybdate @ 0.2 % treatment followed by (43.07 mg/100 g) vitamin-C content under ammonium molybdate @ 0.3 % treatment (Table 3). These attributes might be due to Molybdenum (Mo) is an essential micronutrient for plant as it directly related to metabolic function of nitrogen in the plant through nitrate reductase enzyme that reduces the nitrate to nitrite that ultimately improve the biochemical properties (Hassan *et al*. (2013) [7] and Singh *et al*. (2018) [30].

The interaction effect of boric acid and ammonium molybdate played significant role in increasing the TSS and vitamin-C content in cauliflower curds. The maximum (9.28 ° Brix) total soluble solids in curds was recorded under plants sprayed with boric acid @ 0.5 % + ammonium molybdate @ 0.2 % (Table 3). In case of vitamin C content, the maximum (46.07 mg/100 g) vitamin-C was recorded under boric acid @ 0.5 % + ammonium molybdate @ 0.2 % treatment followed by (43.90 mg/100 g) and (43.87 mg/100 g) under boric acid @ 1.0 % + ammonium molybdate @ 0.2 % and boric acid @ 0.5 % + ammonium molybdate @ 0.5 % treatments, respectively (Table 3).

In interaction effects of boric acid and zinc sulphate, there was non-significant difference was observed on non-reducing sugar and total sugar content in cauliflower except reducing sugar content and the minimum (0.17 %) reducing sugar was recorded under boric acid @ 0.2 % + zinc sulphate @ 0.4 % treatment followed by (0.18 %) under boric acid @ 0.1 % + zinc sulphate @ 0.4 % and boric acid @ 0.3 % + zinc sulphate @ 0.4 % treatments (Table 3). Foliar application of boron and molybdenum improved the biochemical properties of curds significantly as it enhanced the vegetative growth, retention of flowers, speeds up the process of photosynthesis which resultantly increased the photosynthates (CH_2O) by the result of which it increased the TSS, sugar, vitamin C content and ultimately other biochemical properties. Almost similar results were also clarified by Sharma *et al.* (2023) [25] and Hasan *et al.* (2025) [6] in cauliflower.

5. Economics

It is apparent from the data presented in Table 3 revealed that the foliar application of different concentration of boric acid, ammonium molybdate and their interaction effect had significant influence on net return of cauliflower curd production. The maximum net return (₹. 1,99,349.50/ha) and highest (2.72) B: C ratio of cauliflower production was recorded under boric acid @ 0.5 % + ammonium molybdate @ 0.2 % treatment followed by (₹. 1,75,790.76/ha) with (2.52) B:C ratio under boric acid @ 0.5 % + ammonium molybdate @ 0.1 % treatment. Whereas, the minimum net return (₹. 56,684.55 /ha /ha) with lowest (1.50) B:C ratio was recorded in control. Hence, the foliar spray of boric acid @ 0.5 % + ammonium molybdate @ 0.2 % treatment was found the best treatment for getting maximum net return per hectare. It might be due to increasing the size of curds (diameter, length and fresh weight) and maximizing curd weight in foliar application of boric acid and ammonium molybdate that ultimately increased the marketable yield of cauliflower curds per plant as well as per hectare. These results are in close conformity with the findings of Rai *et al.* (2021) [23]; Sharma *et al.* (2023) [25] and Hasan *et al.* (2025) [6].

Table 1: Effect of Boric Acid and Ammonium Molybdate on vegetative growth parameters.

Treatments	Plant height (cm)	No. of leaves per plant	Leaf length (cm)	Leaf width (cm)	Stalk length (cm)
Control	32.02	9.57	15.25	11.78	8.73
Boric Acid @ 0.2 %	33.26	11.41	19.97	16.50	9.21
Boric Acid @ 0.5 %	36.21	11.84	21.06	17.59	9.68
Boric Acid @ 1.0 %	35.89	11.60	20.43	16.96	10.16
SEm ±	0.32	0.02	0.06	0.06	0.38
C.D. (p=0.05)	0.92	0.06	0.19	0.19	1.09
Ammonium Molybdate @ 0.1%	35.23	11.36	19.83	16.36	10.64
Ammonium Molybdate @ 0.2%	37.06	12.27	22.15	18.68	11.11
Ammonium Molybdate @ 0.5%	38.57	12.88	23.70	20.23	11.59
SEm ±	0.32	0.02	0.06	0.06	0.38
C.D. (p=0.05)	0.92	0.06	0.19	0.19	1.09
Boric Acid @ 0.2 % + Ammonium Molybdate @ 0.1%	37.09	12.29	22.21	18.73	12.07
Boric Acid @ 0.2 % + Ammonium Molybdate @ 0.2%	36.43	12.00	21.47	18.00	12.54
Boric Acid @ 0.2 % + Ammonium Molybdate @ 0.5%	41.53	13.79	26.05	22.58	13.02
Boric Acid @ 0.5 % + Ammonium Molybdate @ 0.1%	45.41	16.13	32.02	28.55	16.09
Boric Acid @ 0.5 % + Ammonium Molybdate @ 0.2%	43.03	15.20	29.75	26.27	14.45
Boric Acid @ 0.5 % + Ammonium Molybdate @ 0.5%	38.28	12.37	22.42	18.95	13.97
Boric Acid @ 1.0 % + Ammonium Molybdate @ 0.1%	39.59	12.86	23.66	20.19	13.35
Boric Acid @ 1.0 % + Ammonium Molybdate @ 0.2%	41.15	13.83	26.16	22.68	13.28
Boric Acid @ 1.0 % + Ammonium Molybdate @ 0.5%	38.59	13.28	24.74	21.27	12.90
SEm ±	0.64	0.04	0.13	0.13	0.79
C.D. (p=0.05)	1.84	0.11	0.37	0.37	2.17

Table 2: Effect of Boric Acid and Ammonium Molybdate on yield attributing and yield parameters.

Treatments	Days to 50% curd initiation	Days to 50% curd maturity	Curd diameter (cm)	Curd length (cm)	Curd weight (g)	Marketable curd yield (t/ha)
Control	72.94	83.89	12.72	6.29	538.38	19.54
Boric Acid @ 0.2 %	67.18	78.13	16.50	8.10	567.79	20.61
Boric Acid @ 0.5 %	66.24	77.19	16.96	8.26	597.20	21.68
Boric Acid @ 1.0 %	66.77	77.72	16.70	8.15	626.61	22.74
SEm ±	0.25	0.31	0.14	0.07	12.64	0.43
C.D. (p=0.05)	0.73	0.90	0.42	0.20	36.69	1.25
Ammonium Molybdate @ 0.1%	70.04	79.99	15.33	7.44	656.02	23.81
Ammonium Molybdate @ 0.2%	67.74	78.69	15.59	7.65	685.73	24.89
Ammonium Molybdate @ 0.5%	67.84	79.10	15.85	7.72	715.14	25.96
SEm ±	0.25	0.31	0.14	0.07	12.64	0.43
C.D. (p=0.05)	0.73	0.90	0.42	0.20	36.69	1.25
Boric Acid @ 0.2 % + Ammonium Molybdate @ 0.1%	66.98	77.93	16.70	8.17	744.55	27.02
Boric Acid @ 0.2 % + Ammonium Molybdate @ 0.2%	65.88	76.48	16.48	8.01	774.26	28.10
Boric Acid @ 0.2 % + Ammonium Molybdate @ 0.5%	66.98	77.93	16.30	7.95	802.47	29.13
Boric Acid @ 0.5 % + Ammonium Molybdate @ 0.1%	60.15	70.75	18.66	9.12	993.14	36.05
Boric Acid @ 0.5 % + Ammonium Molybdate @ 0.2%	62.54	73.49	17.69	8.61	890.70	32.33
Boric Acid @ 0.5 % + Ammonium Molybdate @ 0.5%	63.29	74.24	17.17	8.37	861.29	31.26
Boric Acid @ 1.0 % + Ammonium Molybdate @ 0.1%	64.54	75.49	16.69	8.14	823.05	29.87
Boric Acid @ 1.0 % + Ammonium Molybdate @ 0.2%	65.55	76.50	16.91	8.22	819.62	29.75
Boric Acid @ 1.0 % + Ammonium Molybdate @ 0.5%	65.42	76.37	16.82	8.22	795.71	28.88
SEm ±	0.50	0.62	0.29	0.14	25.29	0.86
C.D. (p=0.05)	1.46	1.81	0.83	0.41	73.38	2.49

Table 3: Effect of Boric Acid and Ammonium Molybdate on quality and economics parameters.

Treatments	Sugar content (%)			Vitamin C content (mg/100g)	Net Return (₹./ha)	B:C Ratio
	Reducing Sugar	Non-reducing Sugar	Total Sugar			
Control	0.50	4.58	5.08	30.14	56,684.55	1.50
Boric Acid @ 0.2 %	0.49	4.53	5.02	35.97	65,499.95	1.57
Boric Acid @ 0.5 %	0.49	4.56	5.05	36.40	74,052.34	1.64
Boric Acid @ 1.0 %	0.47	4.53	5.00	36.07	82,080.74	1.70
SEm ±	0.01	0.15	0.15	0.41	---	---
C.D. (p=0.05)	0.02	0.44	0.44	1.19	---	---
Ammonium Molybdate @ 0.1%	0.49	4.31	4.81	38.32	93,821.14	1.82
Ammonium Molybdate @ 0.2%	0.45	4.32	4.77	41.38	1,03,031.81	1.90
Ammonium Molybdate @ 0.5%	0.45	4.14	4.59	43.44	1,12,147.21	1.98
SEm ±	0.01	0.15	0.15	0.41	0.41	---
C.D. (p=0.05)	N.S.	N.S.	N.S.	1.19	1.19	---
Boric Acid @ 0.2 % + Ammonium Molybdate @ 0.1%	0.43	3.89	4.32	41.46	1,21,412.61	2.06
Boric Acid @ 0.2 % + Ammonium Molybdate @ 0.2%	0.41	3.84	4.24	40.48	1,30,623.29	2.13
Boric Acid @ 0.2 % + Ammonium Molybdate @ 0.5%	0.39	3.78	4.17	43.50	1,39,357.57	2.21
Boric Acid @ 0.5 % + Ammonium Molybdate @ 0.1%	0.37	3.60	3.96	46.06	1,75,790.76	2.52
Boric Acid @ 0.5 % + Ammonium Molybdate @ 0.2%	0.39	3.84	4.23	43.89	1,99,349.50	2.72
Boric Acid @ 0.5 % + Ammonium Molybdate @ 0.5%	0.39	3.97	4.36	43.26	1,57,250.37	2.35
Boric Acid @ 1.0 % + Ammonium Molybdate @ 0.1%	0.41	4.03	4.44	42.88	1,44,245.85	2.23
Boric Acid @ 1.0 % + Ammonium Molybdate @ 0.2%	0.45	4.17	4.62	43.88	1,42,929.16	2.22
Boric Acid @ 1.0 % + Ammonium Molybdate @ 0.5%	0.45	4.28	4.73	42.27	1,35,111.15	2.15
SEm ±	0.01	0.30	0.30	0.82	---	---
C.D. (p=0.05)	0.03	N.S.	N.S.	2.38	---	---

Conclusion

The present investigation clearly demonstrated that foliar application of micronutrients, particularly boron and molybdenum, plays a vital role in improving growth, yield, quality, and economic returns of cauliflower (*Brassica oleracea* var. *botrytis* L.) under semi-arid conditions of Rajasthan. Among individual treatments, boric acid @ 0.5% and ammonium molybdate @ 0.2% significantly enhanced vegetative growth parameters, early curd initiation and maturity, curd size, fresh weight, and marketable yield compared to control. The combined application of boric acid @ 0.5% + ammonium molybdate @ 0.2% proved superior, recording maximum plant height, number of leaves, curd diameter and length, highest fresh curd weight, and marketable yield per hectare. This treatment also improved quality attributes such as total soluble solids and vitamin C content, indicating better nutritional quality of curds. Economically, the same treatment resulted in the highest net return and benefit-cost ratio, making it the most profitable option for farmers. The synergistic effect of boron and molybdenum enhanced physiological and metabolic activities, including carbohydrate translocation, nitrogen metabolism, and photosynthesis, which collectively contributed to improved productivity. Therefore, foliar application of boric acid @ 0.5% along with ammonium molybdate @ 0.2% is recommended for maximizing yield, quality, and profitability of cauliflower cultivation under semi-arid agro-climatic conditions.

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