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Management of onion twister disease through foliar nutrients and fungicide applications

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Abstract
A field experiment was conducted at Haveli Farm, College of Horticulture, Bagalkot, during the *Kharif* seasons of 2023-24 and 2024-25 to evaluate the effect of integrated nutrient management (INM) on twister disease severity and yield of onion (*Allium cepa* L., cv. Arka Kalyan). Eight treatments involving foliar application of micronutrients *viz*., Boron (B), Zinc (Zn), Sulfur (S), Potassium nitrate (KNO_3), calcium nitrate and commercial micronutrient mixtures combined with a combi fungicide product (Azoxystrobin 11% + Tebuconazole 18.3% W/W SC) were tested in a randomized complete block design with three replications. Disease severity was assessed using a 0-5 scale, and per cent disease index (PDI), percent disease reduction over control (PDROC), bulb yield (t/ha) and economic returns through incremental cost-benefit ratio (ICBR) were measured. Across both seasons, foliar application of Boron 20% @ 1 g/l with fungicide (Azoxystrobin 11% + Tebuconazole 18.3% W/W SC) (T2) consistently recorded the lowest disease severity (PDI 23.38% and 21.35%), highest PDROC (55.46% and 57.47%), maximum bulb yield (27.37 and 30.95 t/ha) and superior economic returns (ICBR 1:2.46 and 1:3.24). Other nutrient-fungicide combinations, including calcium nitrate, potassium nitrate and micronutrient mixtures such as Arka Vegetable Special, also significantly reduced disease incidence and improved yield. These results indicate that integrating targeted foliar nutrients with fungicide applications provides an effective, economically viable and environmentally sustainable strategy for managing twister disease in onion.

Keywords: Onion, twister disease, integrated nutrient management, boron, foliar spray, fungicide, yield, economic analysis

Introduction
Onion (*Allium cepa* L.) is the most widely cultivated species of the genus *Allium*, which comprises over 600 species worldwide, including Garlic (*A. sativum*), Leek (*A. ampeloprasum*), Chives (*A. schoenoprasum*) and Shallot (*A. ascalonicum*) (Brewster, 2008; Griffiths *et al*., 2002) [4, 9]. Among these, *A. cepa* is the primary species grown commercially for bulb production globally (FAOSTAT, 2023) [7]. In India, several cultivars and types of onion are cultivated, broadly categorized as short-day, intermediate-day and long-day varieties, suited to different agro-climatic zones (NHRDF, 2022) [15]. Major cultivated varieties include Arka Kalyan, N-53, Bhima Shakti, Pusa Red, and Nasik Red, primarily grown in states like Maharashtra, Karnataka, Gujarat, Madhya Pradesh and Rajasthan (Brewster, 2008; Teshika *et al*., 2019) [4, 21]. Onions are propagated through seeds and transplants, forming a single bulb with layered fleshy leaves (Gupta and Prakash, 2014) [10]. The bulbs are rich in carbohydrates, vitamins (C, B-complex), minerals (K, Ca, Mg) and Organosulfur compounds responsible for their characteristic flavor and health benefits (Griffiths *et al*., 2002; Teshika *et al*., 2019) [9, 21]. Flavonoids such as quercetin provide antioxidant activity (Gupta and Prakash, 2014) [10]. The crop has a shallow, fibrous root system that supports nutrient and water uptake for bulb development (Brewster, 2008) [4]. Different cultivars vary in bulb size, color (white, yellow, red), pungency and storage life, making them suitable for domestic and export markets (FAO, 2020) [6]. Onion cultivation contributes significantly to the economy by generating employment in production, processing, storage, and export chains (FAO, 2020) [6].

Onion productivity is greatly affected by biotic factors, including fungal, bacterial, viral pathogens, and nematodes, causing significant yield losses (Dutta *et al*., 2022; Brewster, 2008) [5, 4]. Twister disease, caused primarily by *Colletotrichum* spp. and sometimes associated with *Fusarium* spp., leads to leaf twisting, curling, neck elongation, abnormal sprouting, slender bulbs and bulb rot, resulting in 20-60 per cent yield loss in India (Patil, 2013; Sonawane *et al*., 2022) [16, 20]. Integrated nutrient management (INM) plays a key role in reducing disease severity and improving plant vigor (Gupta *et al*., 2020) [11]. Foliar and soil application of micronutrients such as boron, zinc, and sulfur strengthens plant tissues and enhances resistance against fungal pathogens (Singh *et al*., 2019; Kumar *et al*., 2021) [19, 13]. Potassium nitrate promotes balanced nutrition, osmotic regulation and overall plant health, reducing susceptibility to twister disease (Awan *et al*., 2023) [2]. Organic manures and biofertilizers improve soil health and stimulate systemic resistance in plants (Manthesha *et al*., 2022) [14]. Combined with cultural practices like proper spacing, crop rotation and removal of infected debris, these nutrients significantly lower disease incidence (Dutta *et al*., 2022) [5]. Nutrient-based management improves bulb yield, size and quality while reducing dependence on chemical fungicides (Barad, 2022) [3]. Adoption of micronutrient-focused INM is essential for sustainable onion production in twister disease-prone areas (Sonawane *et al*., 2022) [20]. The present study is contemplated with an objective of management of twister disease using nutrients and fungicide.

Materials and Methods

Experimental location

A field experiment was conducted to evaluate the effect of integrated nutrient management (INM) on twister disease severity and yield of onion at Haveli Farm, College of Horticulture, Bagalkot, during the *Kharif* seasons of 2023-24 and 2024-25. The experiment was laid out on sandy loam soil with inherently low fertility.

Rasing of seedlings and transplanting

The *Arka Kalyan* cultivar was raised as per package of practice of UHS, Bagalkot. The 40 days old seedlings were transplanted at a spacing of 15 × 10 cm in plots measuring 2 m × 2 m. Uniform application of farmyard manure (FYM) at 30 t/ha was carried out, along with recommended doses of nitrogen, phosphorus, and potassium (125:75:125 kg/ha), as per the package of practices for onion recommended by UHS, Bagalkot.

Treatment imposition

Based on prior nutrient analysis of plant and soil samples from healthy and infected plots, eight distinct treatments involving different micronutrients *viz*., Boron (B), Zinc (Zn), Sulfur (S) and Potassium nitrate (KNO_3) were designed. There were totally eight treatments *viz*., T1-Sulphur 80 WP @ 3 g/l + (Azoxystrobin 11% + Tebuconazole 18.3% W/W SC) @ 1 ml/l, T2-Boron 20% @ 1 g/l + (Azoxystrobin 11% + Tebuconazole 18.3% W/W SC) @ 1 ml/l, T3-Calcium nitrate (15.5:0:0: 18.8) @ 2 g/l + (Azoxystrobin 11% + Tebuconazole 18.3% W/W SC) @ 1 ml/l, T4-Zinc 12% @ 2 g/l + (Azoxystrobin 11% + Tebuconazole 18.3% W/W SC) @ 1 ml/l, T5-Potassium nitrate (13:0:45) @ 2 g/l + (Azoxystrobin 11% + Tebuconazole 18.3% W/W SC) @ 1 ml/l, T6-Micronutrient mixture {Boron (0.50%) + Iron (2.00%)+ Manganese (1.00%)+ Zinc (3.00%)} @ 5 g/l+ (Azoxystrobin 11% + Tebuconazole 18.3% W/W SC) @ 1 ml/l, T7-Arka vegetable special { Zinc (4.50%)+ Boron (1.00%)+ (Manganese (0.85%)+ Iron (2.10%)+ Copper (0.10%)} @ 3 g/l + (Azoxystrobin 11% + Tebuconazole 18.3% W/W SC) @ 1 ml/l and T8-Control. Each treatment was replicated three times in a randomized complete block design (RCBD). Foliar sprays of the selected micronutrients were applied at critical growth stages, along with a combi-product fungicide (Azoxystrobin 11% + Tebuconazole 18.3% W/W SC) at 1 ml/l, administered at 10-day intervals with two consecutive sprays per application schedule.

Assessment of disease and yield

Twister disease index was assessed before and 10 days after each treatment using a 0-5 rating scale (0 = no symptoms, 1 = ≤10 per cent curling/chlorosis, 2 = 11-20 per cent leaf elongation, 3 = 21-40 per cent acervuli on leaf sheath, 4 = 41-60% per cent twisted leaves and slender bulbs, 5 = >60 per cent severe dieback and bulb rot). The Per cent Disease Index (PDI) was calculated using McKinney's formula (1923).PDI= [Sum of all disease ratings/Total number of plants observed × Maximum disease grade]X 100.

Bulb yield per plot was recorded at harvest and extrapolated to tons per hectare. Yield improvement over the untreated control was determined. Economic analysis was conducted by calculating the benefit-cost (B:C) ratio for all treatments.

Statistical analysis

All data were subjected to analysis of variance (ANOVA) using SPSS STATISTICS 2.3 software, and treatment means were compared using Duncan's Multiple Range Test (DMRT) at 5% level of significance to separate homogeneous groups (Gomez & Gomez, 1984).

Results

Disease incidence and yield during 2023-24

Prior to treatment imposition, no significant differences were observed among the treatments. Ten days after the second foliar spray, the untreated control (T8) recorded the highest disease severity with a percent disease index (PDI) of 52.50 per cent. Among the nutrient-fungicide treatments, T2 [Boron 20% @ 1 g/l + (Azoxystrobin 11% + Tebuconazole 18.3% W/W SC @ 1 ml/l)] exhibited the lowest disease severity (23.38% PDI), followed closely by T3 [Calcium nitrate @ 2 g/l + (Azoxystrobin 11% + Tebuconazole 18.3% W/W SC @ 1 ml/l); 24.25% PDI)], T4 [Zinc 12% @ 2 g/l + (Azoxystrobin 11% + Tebuconazole 18.3% W/W SC @ 1 ml/l); 29.58% PDI], T6 [Micronutrient mixture @ 5 g/l + (Azoxystrobin 11% + Tebuconazole 18.3% W/W SC @ 1 ml/l); 30.58% PDI] and T7 [Arka Vegetable Special @ 3 g/l + (Azoxystrobin 11% + Tebuconazole 18.3% W/W SC @ 1 ml/l); 29.75% PDI] (Table 1). Correspondingly, the percent disease reduction over control (PDROC) was highest in T2 (55.46%), followed by T3 (53.81%), T4 (43.65%), T6 (41.75%) and T7 (43.33%).

Significant differences in yield (t/ha) were also observed among treatments. The maximum yield was obtained in T2 (27.37 t/ha), statistically on par with T3 (26.35 t/ha), followed by T6 (23.01 t/ha), T7 (23.20 t/ha) and T4 (22.48 t/ha), while the control yielded the lowest (11.28 t/ha). The percent increase in yield over control (PIYOC) ranged from 14.55 to 58.79%, with the highest improvement in T2 (58.79%).

Disease incidence and yield during 2024-25

During the second season, similar trends were observed. T2 [Boron 20% @ 1 g/l + (Azoxystrobin 11% + Tebuconazole 18.3% W/W SC @ 1 ml/l)] again recorded the lowest PDI (21.35%) ten days after the second spray, followed by T5

[Potassium nitrate 13:0:45 @ 2 g/l + (Azoxystrobin 11% + Tebuconazole 18.3% W/W SC @ 1 ml/l); 21.75%] and T3 (23.25%), with these treatments being statistically comparable. T6, T4, and T7 recorded 31.75, 31.27 and 34.25 per cent PDI, respectively, while the control exhibited the highest disease incidence (50.25%) (Table 2). The PDROC was maximum in T2 (57.47%), followed by T5 (56.67%) and T3 (53.69%).

Yield responses mirrored disease suppression trends. T2 recorded the highest yield (30.95 t/ha), followed by T5 (29.75 t/ha), T3 (27.35 t/ha), T6 (24.32 t/ha), T4 (23.30 t/ha) and T7 (22.65 t/ha), with the control yielding the least (12.35 t/ha). The PIYOC was highest in T2 (60.10%), followed by T5 (58.49%) and T3 (54.84%).

Economics of integrated nutrient management

Economic analysis revealed that T2 provided the maximum incremental cost-benefit ratio (ICBR), recording 1:2.46 in 2023-24 and 1:3.24 in 2024-25. It was followed by T3 (1:2.30; 1:2.61), T5 (1:2.23; 1:3.03), T6 (1:1.79; 1:2.08), T7 (1:1.83; 1:1.80) and T4 (1:1.71; 1:1.91) in respective years, indicating that nutrient-fungicide combinations not only reduced disease severity but also enhanced productivity and profitability (Table 3).

Discussion

Integrated use of nutrients and fungicides enhances disease management by improving plant health and disease resistance by simultaneously suppressing pathogen activity (Simoglou and Dordas, 2006; Amina *et al*., 2023) [18, 1]. This approach offers a synergistic effect and it leads to reduced disease severity and higher yield.

The integrated nutrient management trials conducted during the *Kharif* seasons of 2023-24 and 2024-25 revealed that foliar application of Boron 20% @ 1 g/lit combined with fungicide (Azoxystrobin 11% + Tebuconazole 18.3% W/W SC) resulted in the lowest disease severity and highest yield. In both years, this treatment (T2) showed the maximum percent disease reduction over control (55.46% and 57.47%) and the highest yields (27.37 and 30.95 t/ha) and also highest cost-benefit ratio. Similar disease suppressive effects of boron by foliar spray have been reported by Punja (2020) [17] in canola and Simoglou and Dordas (2006) [18] in wheat. Boron helps by strengthening plant tissues and reducing pathogen entry.

Other nutrient treatments including calcium nitrate (T3), potassium nitrate (T5) and micronutrient mixture like Arka vegetable special (T7) also significantly reduced disease incidence and improved yield. Potassium based nutrition has been shown to suppress diseases and enhance plant health, as reported in earlier studies. Khalifa *et al*. (2017) [12] showed disease suppression and enhanced microbial activity in onions treated with potassium silicate. Likewise, Amina *et al*. (2023) [1] and Faruk (2022) [8] showed the benefits of micronutrient application in managing foliar diseases and increasing crop yield in *Alliums*. These results confirm that nutrient based interventions, when combined with fungicides, offer an effective and economically viable approach to managing twister disease in onion.

Table 1: Per cent disease index of twister disease in onion as influenced by nutrient application during2023-24

Sl. No.	Treatment	Per cent disease incidence (PDI)			PDROC	Yield (t/ha)	PIYOC
		Before spray	10 days after 1st spray	10 days after 2nd spray			
1.	T1-Sulphur 80WP @ 3 g/l + F	9.67±0.58^{a}	24.31±1.84^{bc}	32.70±3.46^{b}	37.71	20.83±2.16^{cd}	45.85
2.	T_2-Boron 20% @ 1 g/l + F	10.00±0.00^{a}	19.55±2.59^{c}	23.38±0.77^{c}	55.46	27.37±2.18^{a}	58.79
3.	T3- Calcium nitrate (15.5:0:0: 18.8) @ 2 g/l + F	10.33±0.29^{a}	21.10±1.28^{c}	24.25±3.01^{bc}	53.81	26.35±2.58^{ab}	57.19
4.	T4- Zinc 12% @ 2 g/l + F	9.67±0.29^{a}	24.92±1.60^{bc}	29.58±1.04^{bc}	43.65	22.48±1.28^{bc}	49.82
5.	T5- Potassium nitrate (13:0:45) @ 2 g/l + F	10.00±0.00^{a}	22.68±3.10^{b}	25.18±1.67^{b}	52.09	25.85±1.46^{cd}	56.36
6.	T6- Micronutrient mixture {Boron (0.50%)+ Iron (2.00%) + Manganese (1.00%) + Zinc (3.00%)} @ 5 g/l + F	9.67±0.29^{a}	24.45±1.77^{bc}	30.58±1.60^{bc}	41.75	23.01±1.32^{abc}	50.98
7.	T7- Arka vegetable special { Zinc (4.50%) + Boron (1.00%) + (Manganese (0.85%) + Iron (2.10%) + Copper (0.10%)} @ 3 g/l + F	10.00±0.00^{a}	24.75±2.73^{bc}	29.75±3.77^{bc}	43.33	23.20±1.00^{abc}	14.55
8.	T8- Control	10.00±0.00^{a}	40.18±3.94^{a}	52.50±4.11^{a}	---	11.28±0.15^{d}	---

F- (Azoxystrobin 11% + Tebuconazole 18.3% W/W SC) @ 1ml/l; PDROC - Per cent disease reduction over control; PIYOC- Per cent increase yield over control

Table 2: Per cent disease index of twister disease in onion as influenced by nutrient application during2024-25

Sl. No.	Treatment	Per cent disease incidence (PDI)			PDROC (%)	Yield (t/ha)	PIYOC (%)
		Before spray	10 days after 1st spray	10 days after 2nd spray			
1.	T1-Sulphur 80 WP @ 3 g/l + F	9.10±0.30^{a}	21.25±1.75^{bc}	32.75±2.50^{b}	34.80	21.43±3.38^{de}	42.37
2.	T2-Boron 20% @ 1 g/l + F	8.77±0.53^{a}	17.35±2.75^{c}	21.35±1.75^{c}	57.47	30.95±1.50^{a}	60.10
3.	T3- Calcium nitrate (15.5:0:0: 18.8) @ 2 g/l + F	8.95±0.30^{a}	18.75±2.00^{bc}	23.25±2.85^{c}	53.69	27.35±2.10^{ab}	54.84
4.	T4- Zinc 12% @ 5 g/l + F	8.78±0.49^{a}	22.75±3.50^{b}	31.27±1.82^{b}	37.74	23.30±2.53^{abc}	47.00
5.	T5- Potassium nitrate (13:0:45) @ 2 g/l + F	8.25±0.00^{a}	17.35±1.50^{c}	21.75±2.25^{c}	56.67	29.75±1.25^{a}	58.49
6.	T6- Micronutrient mixture {Boron (0.50%) + Iron (2.00%) + Manganese (1.00%) + Zinc (3.00%)} @ 5 g/l + F	9.35±0.35^{a}	21.40±1.89^{bc}	31.75±1.85^{b}	36.79	24.32±2.70^{bcd}	49.22
7.	T7- Arka vegetable special { Zinc (4.5 0%) + Boron (1.00%) + (Manganese (0.85%) + Iron (2.10%) + Copper (0.10%)} @ 3 g/l + F	9.25±0.43^{a}	22.75±2.80^{b}	34.25±2.95^{b}	31.82	22.65±2.25^{cd}	45.47
8.	T8- Control + RDF	9.08±0.72^{a}	36.75±1.65^{a}	50.25±2.50^{a}	--	12.35±3.50^{e}	---

F- (Azoxystrobin 11% + Tebuconazole 18.3% W/W SC) @ 1ml/lit; PDROC - Per cent disease reduction over control; PIYOC- Per cent increase yield over control

Table 3: Economics of different nutrient management treatments of onion twister disease (2023-24 and 2024-25)

Sl. No.	Fungicide	Additional Yield t/ha over control	Income increased over control (Rs)	Total cost (Rs)	Net realization (Rs)	ICBR	Additional Yield t/ha over control	Income increased over control (Rs)	Total cost (Rs)	Net realization (Rs)	ICBR
		2023-24					2024-25				
1.	T1	9.55	157575	1,07,834	235861	1: 1.46	9.08	172520	1,09,075	298095	1: 1.58
2.	T2	16.09	265485	1,07,859	343746	1: 2.46	18.6	353400	1,09,100	478950	1: 3.24
3.	T3	15.07	248655	1,07,954	326821	1: 2.30	15	285000	1,09,195	410455	1: 2.61
4.	T4	11.2	184800	1,07,859	263061	1: 1.71	10.95	208050	1,09,100	333600	1: 1.91
5.	T5	14.57	240405	1,07,789	318736	1: 2.23	17.4	330600	1,09,030	456220	1: 3.03
6.	T6	11.73	193545	1,07,918	271747	1: 1.79	11.97	227430	1,09,159	352921	1: 2.08
7.	T7	11.92	196680	1,07,629	275171	1: 1.83	10.3	195700	1,08,870	321480	1: 1.80
8.	T8	0	0	99,509	86611	-	0	0	1,01,750	132900	-

ICBR- Incremental cost benefit ratio

Average price of onion 16.50/kg (2023-24) and 19.00/kg (2024-25);T1 - Sulphur 80 WP @ 3 g/l; T2 - Boron 20% @ 1 g/l + RDF; T_3 - Calcium nitrate (15.5:0:0: 18.8) @ 2 g/l; T4- Zinc 12% @ 2 g/l; T5- Potassium nitrate (13:0:45) 2 g/l; T6- Micronutrient mixture {Boron (0.50%) + Iron (2.00%) + Manganese (1.00%) + Zinc (3.00%)} @ 5 g/l; T7 - Arka vegetable special {Zinc (4.50%) + Boron (1.00%) + (Manganese (0.85%) + Iron (2.10%) + Copper (0.10%)} @ 3 g/l; T8- Control.

Conclusion

The integrated nutrient management approach effectively reduced twister disease severity and enhanced onion yield during both *Kharif* seasons of 2023-24 and 2024-25. Foliar application of Boron 20% @ 1 g/l combined with (Azoxystrobin 11% + Tebuconazole 18.3% W/W SC) (T2) consistently recorded the lowest disease incidence, highest percent disease reduction, and maximum yields, along with superior cost-benefit ratios. Other nutrient-fungicide combinations, including calcium nitrate, potassium nitrate and micronutrient mixtures such as Arka Vegetable Special, also contributed to significant disease suppression and yield improvement. These findings highlight that nutrient based interventions, when integrated with effective fungicides, provide a reliable, economically viable, and environmentally sustainable strategy for managing twister disease in onions.

References

1. Amina U, Jolli RB, Sajja NAS, Jamadar MM. Influence of fungicides, nutrients and bioagents on leaf twisting disease and yield of onion (*Allium cepa* L.). Pest Manag Hortic Ecosyst. 2023;29(1):121-6.
2. Awan S, Khan M, Ahmed R. Effect of integrated nutrient management on growth and disease resistance in onion. J Plant Nutr. 2023;46(7):1024-35.
3. Barad S. Twister disease of onion: Current status and management. J Hortic Sci. 2022;17(1):56-64.
4. Brewster JL. Onions and other vegetable alliums. 2nd ed. CABI Publishing; 2008.
5. Dutta S, Mandal S, Chakraborty P. Major fungal diseases of onion: Distribution, losses, and management. Indian Phytopathol. 2022;75(4):719-30.
6. Food and Agriculture Organization of the United Nations. The vegetable sector in global food systems. FAO; 2020.
7. Food and Agriculture Organization of the United Nations. FAOSTAT statistical database. FAOSTAT; 2023. http://www.fao.org/faostat.
8. Faruk MI. Effect of soil and foliar application of plant nutrients on purple blotch and tip-burn of Garlic. J Agron Res. 2022;4(3):39-49.
9. Griffiths G, Trueman L, Crowther T, Thomas B, Smith B. Onions—A global benefit to health. Phytotherapy Research. 2002;16(7):603-15.
10. Gupta RP, Prakash J. Health-promoting properties of onion and garlic. J Food Sci Technol. 2014;51(11):3234-44.
11. Gupta RP, Prakash J. Role of nutrient management in enhancing crop resistance against fungal diseases. J Agric Sci. 2020;12(5):321-30.
12. Khalifa MMA, Fetyan NAH, Magid MSA, El-Sheery NI. Effectiveness of potassium silicate in suppression white rot disease and enhancement physiological resistance of onion plants, and its role on the soil microbial community. Middle East J Agric Res. 2017;6(2):376-94.
13. Kumar V, Singh R, Sharma P. Micronutrients and organic amendments for sustainable onion production. J Hortic Res. 2021;29(3):220-31.
14. Manthesha B, Patil RB, Kulkarni MS. Survey on incidence of onion twister disease in Kalyan Karnataka region. Int J Curr Microbiol Appl Sci. 2022;11(5):120-8.
15. National Horticultural Research and Development Foundation. Area, production, and productivity of onion in India. NHRDF; 2022.
16. Patil RB. Twister disease of onion: Symptoms, etiology, and management. Karnataka J Agric Sci. 2013;26(2):250-3.
17. Punja ZK. Effects of a foliar fertilizer containing boron on the development of Sclerotinia stem rot (*Sclerotinia sclerotiorum*) on canola (*Brassica napus* L.) leaves. J Phytopathol. 2020;168:47-55.
18. Simoglou KB, Dordas C. Effect of foliar applied boron, manganese and zinc on tan spot in winter durum wheat. Crop Prot. 2006;25:657-63.
19. Singh A, Kumar R, Verma S. Influence of micronutrients on disease resistance in onion. J Plant Nutr Fertil Technol. 2019;25(1):45-54.
20. Sonawane AA, Pawar VC, More SM. Etiology and management of onion twister disease in Maharashtra. J Pharmacogn Phytochem. 2022;11(4):1922-7.
21. Teshika JD, Zakariyyah AM, Zaynab T, *et al*. Traditional and modern uses of onion: A review. Food Rev Int. 2019;35(5):435-58.