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Effect of zeolite application for management of purple blotch through development of disease resistance and quality yield of *kharif* onion (*Allium cepa* L)

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Abstract
The field experiment was conducted to study the zeolite application for management of purple blotch through development of disease resistance and quality yield of *kharif* onion (*Allium cepa* L.) for the period of four years in randomized block design with three replications and ten treatments consisted of eight zeolite treatments, recommended fungicide and absolute control treatment. The application of different zeolite dose recorded significantly lower disease severity of purple blotch of onion as compared to absolute control. The results indicated that 4 sprays of tebuconazole 25.9% EC @ 1 ml/l with RDF treatment recorded the minimum percent disease index (PDI) of purple blotch (17.69%) which was at par with treatment i.e. zeolite 500 kg/ha with RDF (21.88%). The application of zeolite @ 0 kg/ha without RDF i.e. absolute control recorded the maximum percent disease index (43.49%) than rest of the treatments. The 4 sprays of tebuconazole 25.9% EC @ 1.0 ml/l with RDF treatment recorded highest onion yield (129.46 q/ha) which was significantly superior than all treatments of zeolite application. The application of zeolite @ 0 kg/ha without RDF recorded lowest onion yield (84.39 q/ha) than rest of the treatments. Application of zeolite @ 500 kg/ha along with RDF (100 kg N: 50 kg P_2O_5: 50 kg K_20)/ha before transplanting of onion seedlings is recommended for development of resistance against purple blotch and higher yield of *kharif* onion.

Keywords: Zeolite, marketable bulb yield, purple blotch of onion, onion

Introduction
Onion (*Allium cepa* L.) is an important vegetable crop grown in India. Maharashtra and Madhya Pradesh are the major onion growing states in India which contributes 42.73% and 15.23% of total area of country, respectively during 2021-22. Onion was grown on an area of 14.3 lakh hectares with production of 267.4 lakh tonnes and 18.70 tonnes productivity per ha in India during 2021-22. An area and production which having area of 703.8 thousand ha and production of 1047.46 thousand tonnes having productivity 14.89 tonnes per ha in Maharashtra during 2020-21.

Purple blotch of onion caused by *Alternaria porri* is showing symptom of disease on leaves results to heavy yield losses in the bulb and seed crop of onion. Purple blotch of onion disease could cause heavy yield losses ranging from 2.5 to 87.8 percent during *kharif* season. (Srivastava *et al.* 1994) [9] The disease surveys conducted during 1990–91 and reported that purple blotch was found to be severe in both periods, with 5.0–96.5% incidence and 0.09–25.93% intensity in kharif-1990 and rabi-1990-91 season respectively (Gupta *et al.* 1994) [2].

Sonawane *et al* 2020 [6] surveyed purple blotch on onion growing area and reported 27.2% to 52.8% PDI range in Nashik district during kharif 2019. Sonawane *et al.* 2022b [8] surveyed purple blotch (10.00 to 29.00% PDI) and twister diseases (18.72 to 50.21% PDI) of onion and reported that twister disease of onion was serious and emerging disease than purple blotch of onion. The prevalence of pathogens depends upon season, region and variety. Purple blotch of onion is one of the most destructive disease commonly prevailing in major onion growing area and heavy yield losses reported under field conditions in onion crop. Small white sunken spots develop on leaves which enlarge, become zonate and turn purple spots under moist conditions. Zeolite is crystalline structure which consists of SiO_4 and AlO_4 tetrahedrons. However, there is necessity to study zeolite application at the time of transplanting of onion seedlings for management of purple blotch of onion by development of disease resistance.

Materials and Methods

Research experimental location and treatment details: A field experiment was conducted at Onion Grape Research Station, Pimpalgaon Baswant, Nashik Maharashtra during kharif season of 2018-19, 2019-20, 2020-21 and 2021-22. The experimental field is an excellent texture and a depth of over 60 cm as well as a homogeneous and medium black soil. The research experiment was laid down in randomized block design with three replications. The treatment comprised with total 10 treatments *viz.*, T_1: Zeolite @ 0 kg/ha with RDF, T_2: Zeolite @ 100 kg/ha with RDF, T_3: Zeolite @ 200 kg/ha with RDF, T_4: Zeolite @ 300 kg/ha with RDF, T_5: Zeolite @ 400 kg/ha with RDF, T_6:Zeolite @ 500 kg/ha with RDF, T_7: Zeolite @ 600 kg/ha with RDF, T_8: Zeolite @ 700 kg/ha with RDF, T_9: 4 sprays of tebuconazole 25 EC @ 1 ml/l with RDF and T_{10}: Zeolite @ 0 kg/ha Absolute control without RDF The experiments of *kharif* onion were planted on 6.8.2018, 23.07.19, 17.07.2020 and 31.07.2021 during *kharif*-2018, 2019, 2020 and 2021 respectively.

Fertilizer application: Baswant-780 variety of kharif onion was transplanted with spacing of 15 cm x 10 cm in 3.00 m x 2.00 m gross plot size. At the time of transplanting of onion seedlings, an appropriate dose of zeolite fertilizer is applied as per treatment details. Onion seedlings were raised in the nursery bed and transplanted to main field with recommended dose of N P K (100:50:50 kg/ ha) and vermicompost (5 t/ha) as per package of practice. The recommended dose of fertilizer was 100 kg N: 50 kg P_2O_5: 50 kg K_2O per plot was applied during crop growth. Urea was applied in three split doses with half as basal dose and remaining quantity of N was applied in two equal splits at monthly interval after transplanting. Full dose of P_2O_5 and K_2O fertiliser's were applied at the time of transplanting.

Tebuconazole 25.9% EC was sprayed @ 0.1% in four sprays as per treatment details. Purple blotch disease severity observations were recorded at 10 days interval starting from 1 month after transplanting and the final observation was recorded at 3 months after transplanting.

Observations recorded: The percent disease index of purple blotch of onion was recorded on 10 randomly selected plants at 10 days interval by using 0-5 scale as given by Sharma (1986) [5] as follows:

Score Disease Description

0. No disease symptom,
1. A few spots covering 10 percent leaf area,
2. Several purplish brown patches covering up to 20 percent of leaf area,
3. Several patches with paler outer zone covering up to 40 percent leaf area,
4. Leaf streaks covering up to 75 percent leaf area or breaking of the leaves from center and
5. Complete drying of the leaves or breaking of leaves from center

The observations on disease severity were recorded 10 days after last fungicidal spray and the percent disease index (PDI) was calculated as per the formulae given by Wheeler (1969) [10].

$$PDI = \frac{\text{Sum of individual ratings}}{\text{Total No. of leaves observed}} \times \frac{100}{\text{Max. Grade}}$$

Statistical analysis: The percent disease severity and yield data for *kharif*-18, *kharif*-19, *kharif* -20 and *kharif* -21 seasons were pooled and subjected to analysis by INDOSTAT program.

Results and Discussion

Effect of application of zeolite at the time of transplanting of onion seedlings on disease intensity of purple blotch of onion: From the pooled data (Table 1) (2018-19, 2019-20, 2020-21 and 2021-22) the percent disease index revealed that the application of different zeolite dose recorded significantly lower disease intensity of purple blotch of onion as compared to absolute control. The data presented in Table 1 indicated that the treatment T_9 @ 4 sprays of tebuconazole 25.9% EC @ 1 ml/l with RDF recorded the minimum percent disease index (PDI) of purple blotch (17.69%) which was at par with treatment T_6 @ Zeolite 500 kg/ha with RDF (21.88%). The application of zeolite @ 0 kg/ha without RDF i.e. absolute control recorded the maximum percent disease index (43.49%) than rest of the treatments (Table-1). Mandi *et al.* 2020 [4] revealed that purple blotch disease severity on onion leaves varied from 28.67% to 65.33%. Seed treatment with Vitavax power @ 0.2% along with foliar application of Tebuconazole 25 EC @ 1 ml/l was most effective. The present findings are confirmed with the findings of Kefalogianni, *et al.* 2017 [3]; Sonawane *et al* 2022a [7] reported the spraying of Azoxystrobin @ 0.1% recorded lowest percent disease severity of purple blotch (17.99%) of onion than rest of the treatments.

Effect of application of zeolite before transplanting of onion seedlings on marketable bulb yield of onion: From the pooled data of onion yield (Table 2) observed that the treatment T_{10}: 4 sprays of tebuconazole 25.9% EC @ 1.0 ml/l with RDF recorded maximum onion marketable yield (129.46 q/ha) which was significantly superior than all treatments of zeolite application. The application of zeolite @ 0 kg/ha without RDF recorded lowest onion yield (84.39 q/ha) than rest of the treatments These findings were supported by Sonawane *et al* 2022a [7] reported the spraying of Azoxystrobin 23 SC @ 0.1% recorded highest marketable yield (128.32 q/ha) than rest of the treatments. Mandi *et al.* 2020 [4] reported that Tebuconazole 25 EC @ 1 ml/l recorded maximum bulb yield (145.8 q /ha) which was statistically at par with Azoxystrobin 23 SC @ 1 ml/l. The earlier research work is inconformity with the results of Bybordi *et al* 2018 [1] who reported that zeolite application helps to increase the qualitative and quantitative traits in onion.

Table 1: Effect of zeolite application on percent disease index of purple blotch disease of *kharif* onion (Pooled data *kharif* 2018, 2019, 2020 & 2021)

Tr. No.	Treatments details	Purple blotch of onion (PDI %)				
		2018	2019	2020	2021	Pooled Mean
T_1	Zeolite @ 0 kg/ha with RDF	36.60 (37.21)	36.30 (37.05)	32.07 (34.48)	38.47 (38.30)	35.86 (36.78)
T_2	Zeolite @ 100 kg/ha with RDF	36.33 (37.06)	34.67 (36.07)	29.93 (33.17)	33.00 (35.06)	33.48 (35.34)
T_3	Zeolite @ 200 kg/ha with RDF	43.13 (41.03)	41.60 (40.12)	27.00 (31.58)	31.80 (34.32)	35.88 (36.71)
T_4	Zeolite @ 300 kg/ha with RDF	33.33 (35.26)	33.77 (35.52)	25.13 (30.09)	28.73 (32.41)	30.24 (33.32)
T_5	Zeolite @ 400 kg/ha with RDF	24.87 (29.91)	24.73 (29.81)	21.20 (27.37)	24.07 (29.38)	23.72 (29.13)
T_6	Zeolite @ 500 kg/ha with RDF	22.53 (28.33)	21.60 (27.67)	20.13 (26.61)	23.27 (28.84)	21.88 (27.88)
T_7	Zeolite @ 600 kg/ha with RDF	35.67 (36.64)	35.93 (36.77)	23.93 (29.26)	25.80 (30.52)	30.33 (33.33)
T_8	Zeolite @ 700 kg/ha with RDF	36.00 (36.83)	30.20 (33.31)	22.44 (28.26)	26.80 (31.18)	28.86 (32.41)
T_9	4 sprays of Tebuconazole 25.9% EC@ 1 ml/l (Univ. Rec.) with RDF	20.67 (27.03)	21.40 (27.51)	17.00 (24.33)	11.67 (19.95)	17.69 (24.73)
T_{10}	Absolute control without RDF & Zeolite @ 0 kg/ha	41.07 (39.84)	45.80 (42.59)	41.60 (40.15)	45.47 (42.40)	43.49 (41.25)
	S.E.±	1.26	1.09	1.09	0.82	0.99
	CD at 5%	3.75	3.25	3.23	2.45	2.88
	CV	6.26	5.46	6.16	4.42	5.99

Table 2: Effect of zeolite application on marketable yield of *kharif* onion (Pooled data *kharif* 2018, 2019, 2020 & 2021)

Tr. No.	Treatments details	Marketable Yield (q/ha)				
		2018	2019	2020	2021	Pooled Mean
T_1	Zeolite @ 0 kg/ha with RDF	89.85	98.85	91.96	105.19	96.46
T_2	Zeolite @ 100 kg/ha with RDF	87.80	92.19	95.41	112.69	97.02
T_3	Zeolite @ 200 kg/ha with RDF	90.85	93.35	99.03	111.97	98.80
T_4	Zeolite @ 300 kg/ha with RDF	93.60	96.69	96.08	119.97	101.59
T_5	Zeolite @ 400 kg/ha with RDF	101.74	110.47	106.60	122.69	110.38
T_6	Zeolite @ 500 kg/ha with RDF	113.91	116.13	126.25	127.36	120.91
T_7	Zeolite @ 600 kg/ha with RDF	85.80	87.80	102.82	119.97	99.13
T_8	Zeolite @ 700 kg/ha with RDF	90.35	92.15	95.52	106.41	96.11
T_9	4 sprays of tebuconazole 25.9% EC @ 1 ml/l with RDF	115.02	124.25	135.60	141.97	129.46
T_{10}	Absolute control without RDF & Zeolite @ 0 kg/ha	73.24	84.46	77.18	102.69	84.39
	S.E.±	9.13	9.51	15.85	11.94	11.61
	CD at 5%	27.12	28.26	47.10	35.46	34.49
	CV	16.30	16.49	26.80	17.82	19.36

Conclusion

Reduction in purple blotch disease and increase in yield of onion observed in the present studies might be due to different mechanisms and role of zeolite application which needs further confirmation. However, it is evident from the present study that the application of zeolite 500 kg/ha helps in reducing the purple blotch disease severity in onion and one of the strategies in disease management.

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