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Gitte AT
Department of Agricultural Botany, VNMKV, Parbhani, Maharashtra, India

Salunke VD
Department of Agricultural Botany, VNMKV, Parbhani, Maharashtra, India

Mundhe AG
Department of Agricultural Botany, VNMKV, Parbhani, Maharashtra, India

Correspondence
Gitte AT
Department of Agricultural Botany, VNMKV, Parbhani, Maharashtra, India

Effect of exogenous application of different chemicals on chlorophyll content, seed set percentage and yield in wheat (*Triticum aestivum* L.)

Gitte AT, Salunke VD and Mundhe AG

Abstract
A field experiment was conducted for the two successive seasons of 2016-17 and 2017-18 at the Research Farm, Wheat and Maize research unit, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani (Maharashtra state) to study the effect of foliar application of chemicals: glycine betaine (600 ppm), salicylic acid (400 ppm), salicylic acid (800 ppm), ascorbic acid (10ppm) + citric acid (1.3%), α-tocopherol (150ppm), KCL 1% and control (no spray) and different sowing dates i.e. 25th November, 15th December and 5th January on chlorophyll content (mg/g), seed set percentage(%) and grain yield (g/ plant) of wheat plant(*Triticum aestivum* L.) cv.NIAW-3096. These chemicals were applied at boot leaf stage and grain filling stage. The data indicated that, an enhancement effect of chlorophyll content (mg/g), seed set percentage (%) and grain yield (g/ plant) was obtained by foliar application of Ascorbic acid 10ppm+citric acid 1.3% with sowing date 25th November.

Keywords: wheat, glycine betaine, salicylic acid, ascorbic acid, citric acid, α- tocopherol (150ppm), KCL 1%

Introduction

Wheat (*Triticum aestivum* L.) is the important staple food crop of India. Wheat is consumed in various preparations such as *dalia*, *halwa*, sweet meals *etc*. In urban areas of India wheat is used for making bread, flakes, cakes, biscuits *etc*. Wheat straw is a good source of feed for a large population of cattle in India and also used for manufacturing of straw boards, papers and other pulp products. In India due to delay in harvest of previous crops viz. rice and maize, the crop gets exposed to higher ambient temperature of the summer as well as hot spells, at the time of grain filling, which cause significant reduction in grain yield. Terminal heat stress caused by high temperature during wheat grain development is an important constraint during wheat production. In Maharashtra, wheat occupies second position next to sorghum. The low productivity level is due to various factors like fluctuations in atmospheric temperatures, non-availability of sufficient irrigation water, non-adoption of improved package of practices, particularly recommended seed rate, spacing and fertilizers levels.

Terminal heat stress causes an array of physiological, biochemical and morphological changes in plant, which effect plant growth and development (Kumar *et al.*, 2012) [8]. One of the programmatic approaches is the exogenous use of stress alleviating compounds, inorganic salts, natural and synthetic plant growth regulators and stress signaling molecules have been used based on their specific properties and roles to improve germination and subsequent growth in a number of grain, forage and horticultural crops (Wahid *et al.*, 2007) [19]. Heat and drought stress in field crops can be managed by applying chemicals like salicylic acid, glycine betaine, ascorbic acid, citric acid, potassium chloride and α-tocopherol which are able to induce long-term thermotolerance in plants and can be helpful in mitigating the yield reduction threats as well as are helpful in producing good quality grains.

The sowing time influence the quality and yield of wheat. Time of sowing is most important factor that govern the crop phonological development and efficient conversion of biomass into economic yield. Normal sowing has longer growth which consequently provides an opportunity to accumulate more biomass as compared to late sowing results in higher grain and biological yields (Singh and Pal, 2003) [14]. Delayed sowing of wheat crop it is exposed to sub-optimal temperature at establishment and supra-optimal temperature at reproductive

Phases that leads to forced maturity and reduction in grain yield. Delay in sowing affect development of plant organs and transfer from source to sink which reflect reduction in vegetative growth and yield and yield components.

Therefore, the present investigation was undertaken to study the impact of spraying of chemicals on chlorophyll content (mg/g), seed set percentage (%) and grain yield (g/ plant) of wheat plant (*Triticum aestivum* L.) cv. NIAW-3096 plants to improve growth and yield parameters.

Materials and Methods

This investigation was carried out at the Research Farm, Wheat and Maize research unit, Vasantrao Naik Marathwada Krishi Vidyapeth, Parbhani (Maharashtra state), during two successive seasons 2016-17 and 2017-18 to study effect of foliar application of chemicals: glycine betaine (600 ppm), salicylic acid(400 ppm), salicylic acid(800 ppm), ascorbic acid (10ppm) +citric acid (1.3%), α- tocopherol (150ppm), KCL 1% and control(no spray) on growth, yield and yield components and biochemical components of wheat plant (*Triticum aestivum* L.) cv. NIAW-3096.

Plant materials

Uniform grains of wheat plant (*Triticum aestivum* L.) cv. NIAW-3096 were obtained from Wheat and Maize research unit, Vasantrao Naik Marathwada Krishi Vidyapeth, Parbhani (Maharashtra state). Grains of the wheat plant cv. NIAW-3096 were sown on 25th November, 15th December and 5th January for the first and the second season respectively. The experimental design was factorial randomized block design, replications**:** 3, Plot size was1.8 m × 6 m (gross), 1.44 m × 6 m (net), recommended dose of fertilizers was applied at the rate of 120:60:40 (NPK, kg ha-1). The chemicals glycine betaine (600 ppm), salicylic acid (400 ppm), salicylic acid (800 ppm), ascorbic acid (10ppm) + citric acid (1.3%), α-tocopherol (150ppm), KCL 1% and control (no spray) were foliarly applied at boot leaf stage and grain filling stage. At maturity, five plants from each replicate were randomly chosen to determine the seed set percentage (%). Seed set percentage (%) was calculated by ratio of total number of awns to total number of grains per panicle.

Yield measurements

The obtained yield from net plot was converted by grain hectare factor into q/ha and was recorded in each treatment and replication.

Quality parameter determination

Chlorophyll content of leaves was estimated at 3 days before spraying and 3 days after spraying of boot leaf stage and 3 days before spraying and 3 days after spraying of grain filling stage according to Arnon (1949) [3].

Statistical analysis

The experimental data obtained on various selected variables were analyzed by the standard method of statistical analysis (Panse and Sukhatme, 1985) [10] for factorial randomized block design. The mean values of different treatments were then worked out along with corresponding standard error of mean (SEm). The critical difference at 5 per cent level of significance was computed. Pooled analysis of data for two years were carried out as per the procedure outlined by Cochran and Cox (1957) [5].

Result and Discussion

The data presented in Table 1 show significant difference in chlorophyll content of wheat due to different chemical treatments and sowing dates.

Sowing date 25th November recorded significantly more chlorophyll content mg/g of 2.16, 2.07, 2.12 mg/g at 3 days after spraying of boot leaf stage, 3.38, 3.32, 3.35 mg/g at 3 days after spraying of grain filling stage during 2016-17, 2017-18 and in pooled analysis which was significantly superior over rest of the two dates however it was at par with second sowing date at 3 days after spraying of boot leaf stage. With increase in sowing date chlorophyll content mg/g was decreased at all stages of growth. Foliar application T_4 was significantly superior over rest of the treatments during 2016-17 at 3days after spraying of boot leaf stage, at 3 days after spraying of grain filling stage, however treatment T_4 was at par with T_2 and T_3 during 2017-18 at all stages of growth except for T_3 in pooled means at 3 days before spraying of boot leaf stage and at 3 days after spraying of grain filling stage. The mean chlorophyll content (mg/g) was not influenced significantly due to interaction of sowing date and foliar application during both the years of the experimentation and in pooled mean.

Data pertaining to seed set percentage (%) as influenced by different treatment in first year, second year and pooled analysis of two years are presented in Table 2. Sowing date 25th November recorded significantly maximum seed set percentage (%) of 92.19, 91.19, and 91.69% during 2016-17, 2017-18 and in pooled analysis. The data shows that with increase in date of sowing seed set percentage (%) decreases. Foliar application of chemical T_4 (Ascorbic acid 10ppm+citric acid 1.3%) recorded significantly highest seed set percentage (%) of 92.39, 91.39, 91.89% during 2016-17, 2017-18 and in pooled analysis. Treatment T_4 was found at par with T_2 (91.95%) during 2016-17, 2017-18 and in pooled means. Control recorded significantly lowest seed set percentage (%) of 80.99, 79.88, 80.44% during 2016-17, 2017-18 and in pooled analysis. The seed set percentage (%) was influenced significantly due to the interaction effect of sowing dates and foliar application of chemicals during first year, second year and pooled data of analysis of the experimentation (Table 3,4,5).

The data related to grain yield (q/ha) is presented in Table 6. Sowing date 25th November recorded significantly more grain yield q/ha of 40.03, 39.02, 39.52 q/ha during 2016-17, 2017-18 and in pooled analysis. Sowing date 5th January recorded significantly lowest grain yield q/ha 31.62, 30.62, 31.12 during 2016-17, 2017-18 and in pooled analysis. Foliar application T_4 (Ascorbic acid 10ppm+citric acid 1.3%) recorded significantly more grain yield q/ha of 41.10, 40.10, 40.60 q/ha during 2016-17, 2017-18 and in pooled analysis. Control recorded significantly lowest grain yield q/ha during 2016-17, 2017-18 and in pooled analysis. The grain yield q/ha was influenced significantly due to the interaction effect of sowing dates and foliar application of chemicals during first year, second year and pooled data of analysis of the experimentation (Table 7, 8, 9).

Table 1: Mean chlorophyll content (mg/g) as influenced by different treatments during 2016- 17, 2017-18 and in pooled analysis

Treatment	Chlorophyll content (mg/g) Before boot leaf stage			Chlorophyll content (mg/g) After boot leaf stage			Chlorophyll content (mg/g) Before grain filling stage			Chlorophyll content (mg/g) After grain filling stage		
	2016-17	2017-18	Pooled Mean	2016-17	2017-18	Pooled Mean	2016-17	2017-18	Pooled Mean	2016-17	2017-18	Pooled Mean
Date of Sowing												
D_1(25Nov)	2.08	2.02	2.05	2.17	2.07	2.12	3.28	3.21	3.25	3.38	3.32	3.35
D_2(15Dec)	1.75	1.68	1.72	2.16	2.00	2.11	3.17	3	3.09	3.27	3.23	3.25
D_3(5 Jan)	1.22	1.2	1.21	1.39	1.29	1.34	3.04	2.98	3	3.14	3.08	3.11
SE ±	0.01	0.03	0.01	0.07	0.06	0.06	0.003	0.03	0.01	0.003	0.01	0.008
CD @ 5%	0.02	0.08	0.05	0.19	0.18	0.21	0.008	0.11	0.05	0.008	0.04	0.02
Chemical Treatments												
T_1(Glycine Betaine 600ppm)	1.68	1.62	1.65	1.93	1.83	1.88	3.18	3.06	3.12	3.28	3.22	3.25
T_2(Salicylic Acid 400ppm)	1.81	1.74	1.78	2.05	1.95	2.00	3.24	3.15	3.18	3.34	3.28	3.31
T_3(Salicylic Acid 800ppm)	1.75	1.68	1.72	2.00	1.90	1.95	3.21	3.09	3.15	3.31	3.25	3.28
T_4 (Ascorbic acid 10ppm+citric acid 1.3%)	1.87	1.81	1.84	2.11	2.01	2.06	3.27	3.21	3.24	3.37	3.31	3.34
T_5(α-tocopherol 150ppm)	1.62	1.62	1.60	1.86	1.76	1.81	3.15	3.01	3.09	3.25	3.2	3.22
T_6 (KCL 1%)	1.57	1.56	1.59	1.80	1.71	1.75	3.12	3.05	3.09	3.22	3.15	3.19
T_7(control)	1.47	1.4	1.44	1.59	1.51	1.55	2.99	2.92	2.96	3.09	3.08	3.08
SE ±	0.01	0.04	0.02	0.10	0.11	0.10	0.004	0.05	0.02	0.004	0.02	0.01
CD @ 5%	0.04	0.14	0.07	0.29	0.31	0.28	0.01	0.16	0.07	0.01	0.06	0.03
Interaction D x T												
SE ±	0.08	0.88	0.04	0.19	0.18	0.19	0.05	0.09	0.04	0.05	0.03	0.02
CD @ 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
GM	1.68	1.63	1.66	1.91	1.81	1.86	3.27	3.07	3.12	3.28	3.21	3.24
CV	2.76	8.83	5.13	16.84	17.69	16.54	0.04	5.42	6.68	0.44	2.11	6.15

Table 2: Mean seed set percentage (%) as influenced by different treatments during 2016- 17, 2017-18 and in pooled analysis

Treatment	Seed set percentage (%) At maturity		
	2016-17	2017-18	Pooled Mean
Date of Sowing			
D_1 (25Nov)	92.19	91.19	91.69
D_2 (15Dec)	90.33	89.38	89.86
D_3 (5 Jan)	81.99	80.94	81.46
SE ±	0.11	0.12	0.11
CD @ 5%	0.29	0.3	0.29
Chemical Treatments			
T_1 (Glycine Betaine600ppm)	89.38	88.38	88.88
T_2 (Salicylic Acid400ppm)	91.95	91.06	91.51
T_3 (Salicylic Acid 800ppm)	91.06	90.07	90.57
T_4 (Ascorbic acid 10ppm+citric acid 1.3%)	91.95	91.39	91.89
T_5 (α-tocopherol 150ppm)	86.71	85.71	86.21
T_6 (KCL 1%)	84.70	83.7	84.2
T_7 (control)	80.99	79.88	80.44
SE ±	0.16	0.17	0.15
CD @ 5%	0.45	0.46	0.45
Interaction D x T			
SE ±	0.27	0.29	0.28
CD @ 5%	0.78	0.79	0.77
GM	88.17	87.17	87.67
CV	0.55	0.57	8.48

Table 3: Interaction effect of Dates of sowing and foliar application on Seed set percentage (%) as influenced by D x T interaction during 2016-17

Dates of sowing	Chemical treatments						
	T_1(Glycine Betaine 600ppm)	T_2(Salicylic Acid400ppm)	T_3(Salicylic Acid 800ppm)	T_4 (Ascorbic acid 10ppm+citric acid 1.3%)	T_5(α-tocopherol 150ppm)	T_6 (KCL 1%)	T_7 (control)
D_1(25Nov)	92.34	95.32	94.31	99.26	90.36	88.37	85.32
D_2(15Dec)	91.37	93.39	92.40	94.10	89.35	87.33	84.31
D_3(5 Jan)	84.41	88.43	86.45	82.47	80.39	78.37	73.31
SE ±	0.28						
CD @ 5%	0.78						
GM	88.16						

Table 4: Interaction effect of dates of sowing and foliar application on seed set percentage (%) as influenced by D x T interaction during 2017-18

Dates of sowing	Chemical treatments						
	T_1(Glycine Betaine600ppm)	T_2(Salicylic Acid 400ppm)	T_3(Salicylic Acid 800ppm)	T_4 (Ascorbic acid 10ppm+citric acid 1.3%)	T_5(α-tocopherol 150ppm)	T_6 (KCL 1%)	T_7 (control)
D_1(25Nov)	91.34	94.32	93.31	98.26	89.36	87.37	84.32
D_2(15Dec)	90.37	92.39	91.41	93.43	88.35	86.33	83.31
D_3(5 Jan)	83.41	87.43	85.45	81.47	79.39	77.37	71.98
SE $\pm$	0.29						
CD @ 5%	0.79						
GM	87.16						

Table 5: Interaction effect of dates of sowing and foliar application on seed set percentage (%) as influenced by D x T interaction during pooled means

Dates of sowing	Chemical treatments						
	T_1(Glycine Betaine600ppm)	T_2(Salicylic Acid 400ppm)	T_3(Salicylic Acid 800ppm)	T_4 (Ascorbic acid 10ppm+citric acid 1.3%)	T_5(α-tocopherol 150ppm)	T_6 (KCL 1%)	T_7 (control)
D_1(25Nov)	91.34	94.82	93.81	98.76	89.36	87.37	84.82
D_2(15Dec)	90.87	92.89	91.91	93.77	88.85	86.83	83.81
D_3(5 Jan)	83.41	87.43	85.95	81.97	79.89	77.87	72.65
SE $\pm$	0.27						

Table 6: Mean grain yield q/ha as influenced by different treatments during 2016- 17, 2017-18 and in pooled analysis

Treatments	Grain yield q/ha		
	At harvest		
	2016-17	2017-18	Pooled Mean
Date of Sowing			
D_1(25Nov)	40.03	39.02	39.52
D_2(15Dec)	35.32	34.69	35.00
D_3(5 Jan)	31.62	30.62	31.12
SE $\pm$	0.24	0.29	0.28
CD @ 5%	0.69	0.81	0.81
Chemicals			
T_1 (Glycine Betaine600ppm)	35.38	34.38	34.88
T_2 (Salicylic Acid400ppm)	39.51	38.51	39.01
T_3 (Salicylic Acid 800ppm)	37.48	36.47	36.97
T_4 (Ascorbic acid 10ppm+citric acid 1.3%)	41.10	40.10	40.60
T_5 (α-tocopherol 150ppm)	33.63	32.63	33.13
T_6 (KCL 1%)	32.27	31.27	31.77
T_7 (control)	30.21	30.09	30.15
SE $\pm$	0.38	0.44	0.43
CD @ 5%	1.05	1.24	1.21
Interaction D x T			
SE $\pm$	0.66	0.77	0.73
CD @ 5%	1.82	2.15	2.07
GM	35.65	34.78	35.22
CV	5.20	7.87	6.80

Table 7: Interaction effect of dates of sowing and chemical treatments on grain yield q/ha asinfluenced by D x T interaction during 2016-17

Date of sowing	Chemical treatments						
	T_1(Glycine Betaine600ppm)	T_2(Salicylic Acid 400ppm)	T_3(Salicylic Acid 800ppm)	T_4(Ascorbic acid 10ppm+citric acid 1.3%)	T_5(α-tocopherol 150ppm)	T_6 (KCL 1%)	T_7 (control)
D_1(25Nov)	40.25	44.61	42.33	45.51	38.27	36.78	32.45
D_2(15Dec)	35.44	39.54	37.59	41.29	33.38	32.11	27.86
D_3(5 Jan)	30.45	34.39	32.52	36.50	29.26	27.93	30.31
SE $\pm$	0.66						
CD @ 5%	1.82						
GM	35.65						

Table 8: Interaction effect of dates of sowing and chemical treatments on grain yield q/hainfluenced by D x T interaction during 2017-18

Date of sowing	Chemical treatments						
	T_1(Glycine Betaine600ppm)	T_2(Salicylic Acid 400ppm)	T_3(Salicylic Acid 800ppm)	T_4(Ascorbic acid 0ppm+citric acid 1.3%)	T_5(α-tocopherol 150ppm)	T_6 KCL 1%)	T_7 (control)
D_1(25Nov)	39.25	43.59	41.33	44.51	37.27	35.78	31.45
D_2(15Dec)	34.44	38.54	36.58	40.29	32.38	31.11	29.53

D_3(5 Jan)	29.45	33.39	31.52	35.50	28.25	26.93	29.31
SE ±	0.77						
CD @ 5%	2.15						
GM	34.78						

Table 9: Interaction effect of Dates of sowing and chemical treatments on grain yield q/ha asinfluenced by D x T interaction during pooled

Date of sowing	**Chemical treatments**						
	T_1 (Glycine Betaine600ppm)	**T_2 (Salicylic Acid 400ppm)**	**T_3 (Salicylic Acid 800ppm)**	**T_4 (Ascorbic acid 10ppm+citric acid 1.3%)**	**T_5 (α-tocopherol 150ppm)**	**T_6 (KCL 1%)**	**T_7 (control)**
D_1(25Nov)	39.75	44.10	41.83	45.01	37.77	36.28	31.95
D_2(15Dec)	34.94	39.04	37.08	40.79	32.88	31.61	28.69
D_3(5 Jan)	29.95	33.89	32.02	36.00	28.75	27.43	29.81
SE ±	0.73						
CD @ 5%	2.07						
GM	35.22						

Discussion

Ascorbate is a major metabolite in plants. It is an antioxidant and, in association with other components of the antioxidant system, protects plants against oxidative damage resulting from aerobic metabolism, photosynthesis and a range of pollutants (Smirnoff, 1996) [18]. Citric acid play an important role in plant metabolism. At environmental stress as heat stress, organic acids due to their molecules auto (ox-reduction) properties, act as cofactors for some specific enzymes, i.e., dismutases, catalases and peroxidases, those catalyzed breakdown of the toxic H2O2, OH, O-2 (radicals)) (Aono *et al*. 1993) [2]. Citric acid as non enzymatic antioxidant in chelating these free radicals and protecting plant from injury could result in prolonging the shelf life of plant cells and improving growth characters (Rao *et al*. 2000) [12].

In the present results, chlorophyll content (mg/g) determined at different stages was significantly influenced due to different sowing dates during both the year 2016-17, 2017-18 and pooled data (Table 1). The sowing of wheat at D_1 (25th November) i.e., 47 MW recorded significantly higher chlorophyll content (mg/g) as compared to D_2 (15th December) and D_3 (1st January). Chlorophyll content (mg/g) was recorded significantly higher during the year 2016-17 as compared to 2017-18 and pooled analysis. Singh *et al*. (2002) [14] reported that chlorophyll content (mg/g) was higher in 10th and 30th October sowing as compared to 20th November and 10th December sowing chlorophyll content. The maximum chlorophyll content (mg/g) was found with foliar application of chemical T_4 (Ascorbic acid 10ppm+citric acid 1.3%) at 3 days after spraying of boot leaf stage, 3 days after spraying of grain filling stage and was significantly superior over rest of the chemicals treatments however treatment T_4 was at par with T_2 and T_3 during 2017-18 at all stages of growth except for T_3 in pooled means at 3 days before spraying of boot leaf stage and at 3 days after spraying of grain filling stage. Khodary (2004) [7] observed a significant increase in growth characterstics, pigment contents and photosynthetic rate in maize, sprayed with SA. Stressed wheat plants supplied with 0.3 mM SA recorded 32 % higher chlorophyll content (Wang, 2014) [20].

Seed set percentage (%), significantly influenced due to different sowing time during the year 2016-17, 2017-18 and pooled data (Table 2). The sowing of wheat at D_1 (25th November) i.e., 47 MW recorded significantly higher seed set percentage (%) as compared to D_2 (15th December) 50th MW and D_3 (5thJanuary) 01st MW. The sowing of wheat on D_3 (5th January) recorded significantly lowest seed set percentage (%). Seed set percentage (%) was higher during the year 2016-17 as compared to 2017-18 and pooled analysis. Mohammed and Tarpley (2011) reported that glycine betaine (2.0 kg ha-1) treated plants or salicylic acid (12.9 g ha-1) -treated plant showed 14% and 18% increase in seed set percentage(%) respectively, compared to untreated plants. Seed set percentage(%), significantly influenced due to different chemicals treatments during the year 2016-17,2017-18 and in pooled analysis. The maximum seed set percentage (%) was found with foliar application of chemical T_4 (ascorbic acid 10ppm+citric acid 1.3%) at all growth stages and was significantly superior over rest of the chemicals treatments. Treatment T_4 was found at par with T_2 during 2016-17, 2017-18. And pooled means. Seed set percentage (%) was differed significantly due to sowing dates and chemical treatments interaction during 2016-17,2017-18 and pooled data (Table 3,4,5). Treatment combination D_1T_4 (25th November + T_4 (Ascorbic acid 10ppm+citric acid 1.3%)recorded highest seed set percentage(%)and it was found at par with D_1T_2, D_1T_3 and D_1T_1during 2016-17,2017-18 and pooled data.

The grain yield (kg/ha) at D_1 (25th November) i.e.47 MW sowing date was significantly superior over rest of sowing dates. Reported significantly higher grain yield of wheat when sown on 10th November compared to other sowing dates. Similar results were reported by Patel *et al*., (1982) [11] and Singh and Dixit (1985) [14]. Shirsath (2013) reported that timely sown (23rd November) wheat recorded significantly more grain yield as compared to mid sown (9 December) and late sown (23rd December) wheat. The grain yield (kg/ha) was maximum with foliar application of chemical treatment T_4 (Ascorbic acid 10ppm+citric acid 1.3%) was significantly superior over rest of the chemical treatments during 2016-17, 2017-18 and in pooled analysis Table (6). Amin *et al*. 2008 reported that foliar application of salicylic acid (100 mg/L) resulted in the highest increase in yield and its components. The treatment combination of D_1 T_4 (D1 (25th November) + T_4 (Ascorbic acid 10ppm+citric acid 1.3%) recorded maximum grain yield (q/ha) as compared to rest of all the treatment combination during 2016-17, 2017-18 and pooled analysis (Table 7, 8, 9). Treatment combination D_1 T_4 was found at par with D_1T_2 during 2016-17, 2017-18 and pooled mean. The treatment combination D_3T_7 (Date of sowing 5thJanuary + control (no spray)) recorded lowest grain yield (q/ha). Amin *et al*. (2008) [1] reported that interaction effect of salicylic acid 100mg/l combined with ascorbic acid 200 or 400mg/l significantly increased growth characters, yield and its components, photosynthetic pigment content in leaves, total carbohydrate% in wheat grains. Godara (2014) [6] reported that application of salicylic acid (50 and 100 ppm) significantly influenced physiological parameters and yield &

yield attributes of Indian mustard under normal as well as late and very late sown conditions. Treatment combination D_1T_4 (25^{th} November + T_4 (Ascorbic acid 10ppm+citric acid 1.3%) recorded highest seed set percentage(%) and it was found at par with D_1T_2, D_1T_3 and D_1T_1during 2016-17,2017-18 and pooled data.

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