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# Effect of chemicals and PGRs on quality parameters of durum wheat under rainfed conditions of Bhal region of Gujarat

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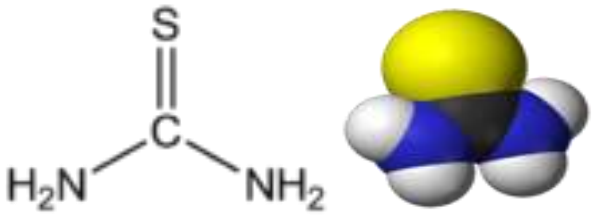
**Abstract**
Drought is the most limiting factor for production in semi-arid ecosystem of Gujarat. Under changed climate scenario due to variability in rain fall pattern problem of drought aggravated. In order to investigate the effect of foliar spray of different chemicals and PGRs o no durum wheat under conserved moisture condition at Agricultural Research Station, AAU, Dhandhuka, Bhal tract of Gujarat in rabi season cultivation 2014-15 to 2016-17. The experiment was carried out in randomized block with eight treatments in three replications viz; $T_{0}$ = Control, $T_1$ = Water spray, $T_2$ = Salicylic acid (100 ppm), $T_3$ = Thioglicolic acid (100 ppm), $T_4$ = Murate of potash (0.5%), $T_5$ = Calcium nitrate (0.2%), $T_6$ = Brassinolide (5 ppm), $T_7$ = NAA (40 ppm), $T_8$ = Thiourea (500 ppm) with absolute control ($T_{0}$ = Control) and spray wad made at two stages of crop first on tillering stage and ear emergence and two sampling was done and each sampling were collect for biochemical analysis 10 days after each spray (tillering stage & ear emergence) of chemicals & PGRs to crop. Among the treatments imposed, result revealed that total chlorophyll content mg/fresh weight, Relative water content (RWC), antioxidant activates gm/100 mg, proline content mg/100 gm, glycine betaene mg/100 gm and protein content gm/100 mg was found significantly higher with $T_8$ treatment (Thiourea 500 ppm) over the control and treatment no 6 (Brassinolide (5 ppm) was fond at par with $T_8$ treatment in first sampling. whereas in second sampling significantly higher data of total chlorophyll content mg/fresh weight (3.358), moisture % (72.156) RWC % (81.71) AOA gm/100 mg (2.271), proline content mg/100 gm (32.96), glycine betaene mg/100 gm (232.86) and protein content gm/100 mg (6.937) was found with $T_8$ (Thiourea 500 ppm) treatment over control.

**Keywords:** Wheat, proline content TGA, Brassinolide, salicylic acid and thiourea

## Introduction
Durum wheat (*Triticum durum* L.) is the second most important species globally as well as nationally grown after bread wheat (*Triticum aestivum* L.). In fact durum wheat was the predominantly grown in Central India, particularly in the Malwa region in Madhya Pradesh, Bhal and coastal agro-climatic zone in Gujarat, Southern Rajasthan and Bundelkhand region of Uttar Pradesh. Total durum wheat production in India is sharing about 4 to 10 percent of total wheat production. (Anon., 2017) [1]. Due to climate change heat stress at maturity stage becomes a regular phenomenon in recent years and drought is the most limiting factor in production in semi arid ecosystem of Gujarat. Under changed climate scenario due to variability in rainfall pattern problem of drought aggravated. Primarily the failure, prolonged dry spells and erratic behavior of south – west monsoon are the major cause of drought. Besides moisture stress, heat stress is also a very important factor that affects the agricultural production worldwide due to climate change (Hall, 2011) [4]. Bio-regulatoris a group of naturally occurring growth promoting phytohormones, which regulates several physiological processes like cell division, cell elongation, and synthesis of nucleic acid and proteins. Use of bio-regulators has offered new avenues for enhancing productivity of several crops. Partitioning of dry matter to yield storage organs is considered to be a major determinant for agricultural yield and this is dependent on the efficiency of photosynthate translocation in crop during grain filling period when developing grains are the storing sink. It has been reported that bio-regulators plays important role in greater partitioning of photosynthates towards reproductive sink there be improving the harvest index (Kumar *et al*. 2018) [7]. Thiourea, is thiocarbamide, an organic compound that resembles urea but contains sulphur instead of oxygen; *i.e.*, the molecular formula is CS $(NH_2)^2$




Thiourea contains 42.1 percent sulphur and 36.8 percent nitrogen. Thus it behaves in the physiology of plants both as a sulfhydryl compound and as an amino compound like urea. The stimulatory action of thiourea in various physiological processes of plant is well known. Thiourea is mainly known for its dormancy breaking and germination stimulating effect (Mayber *et al.*, 1958) [8]. Thiourea has been reported to have a role in improving photosynthetic efficiency and translocation of photosynthates (Sahu *et al.*, 1993) [13]. Salicylic acid (SA), Brassinolide and thioglycolic acid (TGA) has offered new avenues for enhancing productivity of several crops through stress migration.

## Materials and Methods

A field experiment was conducted at Agricultural Research Station, Anand Agricultural University, Dhandhuka (Gujarat) during two consecutive rabi seasons of 2014-15 to 2016-17 to determine the effect foliar spray of chemicals and PGRs on quality parameters of durum wheat under rainfed conditions of Bhal region of Gujarat. Total nine treatments was sprayed out viz; $T_0$ = Control, $T_1$ = Water spray, $T_2$ = Salicylic acid (100 ppm), $T_3$ = Thioglicolic acid (100 ppm), $T_4$ = Murate of potash (0.5%), $T_5$ = Calcium nitrate (0.2%), $T_6$ = Brassinolide (5 ppm), $T_7$ = NAA (40 ppm), $T_8$ = Thiourea (500 ppm) on two crop growth stages crop first on tillering stage and ear emergence, were carried out in Randomized Block Design with three replications on durum wheat, variety GW 1 sown under conserved moisture condition with 60 kg seed rate at 30 cm spacing and full recommended dose of nitrogen (20 kg N/ha) and phosphorus (12.5 kg $P_2O_5$/ha) were applied in the form of urea and single super phosphate, respectively as basal at the time of sowing in all the plots. No irrigation applied because durum wheat crop was sown under conserved soil moisture condition. The maximum and minimum temperature fluctuate between 45.5 °C to 8.2 °C.

### Methodology followed for recording observations of quality parameters

#### (A) Total chlorophyll content (mg/g of fresh weight)

The representative fresh leaf samples were taken to determine chlorophyll content of leaves. These were washed with distilled water and dried with blotting paper. Out of this, 50 mg sample was taken in Mortar and ground well by Pestle with 5 ml 80 percent acetone and centrifuged at 2000 rpm and made the final volume to 10 ml. Absorbance of clear supernatant was measured by Spectronic-20 at 652 nm. The chlorophyll content was expressed in mg $g^{-1}$ of fresh weight of leaves (Arnon, 1949) [2].

$$\text{Total chlorophyll} = \frac{A(652) \times 29 \times \text{Total volume (ml)}}{\alpha \times 1000 \times \text{weight of sample (g)}}$$

Where, α is the path length = 1 cm

#### (B) Proline content (%)

Proline content in plants is determinate by the colorimetric assay method at acidic pH, nin-hydrin can from a red product with proline & omithine used for the estimation of concentration of these amino acids in pure solution (Sunkar R, 2010) [18]

$$\text{Proline content} = G.F \times O.D \times \frac{\text{Total volume}}{\text{Taken volume}} \times \frac{1}{\text{sample weight}} \times 10^{-6}$$

Where,
G.F = Graf factor (94.67)
O.D = Optical density

#### (C) Antioxidant activities (%)

The principle of this method is based on the reduction of a ferric-tripyridyl-triazine complex to its ferrous, colored form in the presence of antioxidants. Sample extraction done by takeone gram sample extract in 0.1% HCl in 60% Methanol. Shake for 4 (four) hrs. at room temperature. Filter or centrifuge and use as a sample.

$$AOA\ (\%) = G.F \times O.D \times \frac{\text{Total volume}}{\text{Taken volume}} \times \frac{1}{\text{sample weight}} \times 10^{-6}$$

Where,
G.F = Graf factor (114.50)
O.D = Optical density

#### (D) Relative water content (%)

The RWC express the water content in percent at a given time as related to the water content at full turgor

$$RWC = \frac{\text{Fresh weight} - \text{dry weight}}{\text{Saturated weight} - \text{dry weight}} \times 100$$

## Results and Discussion

Under deficit irrigation and low moistuire, the production losses owing to different environmental stresses is a major concern to cope with rising food needs (Shanker and Venkateswarlu, 2011) [15]. Application of plant bioregulators (PBRs) could play a crucial role in improving crop growth, development and productivity (Pasala *et al.*, 2016) [10]. Quality parameters like chlorophyll content, moisture %, relative water content %, proline content and glycine betaene of durum wheat differed significantly with foliar spray of chemicals and PGRs viz; salicylic acid, thioglicolic acid, Brassinolide and thiourea on two growth stages tillering stage & ear emergence.

### 1. Chlorophyll content (mg/fresh weight)

An examination of 2nd spray of three year pooled data indicated (Table no 1) that foliar spray of different chemicals & PGRs numerically increased the chlorophyll content but significantly higher chlorophyll content mg/fresh weight (3.358) was recorded in all years and in polled analysis with $T_8$ treatment Thiourea (500 ppm) which is found at par with treatment $T_4$ (MOP 0.5%). Sharma and Kumar (2009) [16] at Hisar reported that the significantly higher Chlorophyll content 14.2% was observed in thiourea sprayed.

**Table 1:** Effect of chemicals and PGRs on total Chlorophyll content (mg/fresh weight) 2nd sampling under conserved moisture condition of durum wheat

| Treatments | Years | | | |
|---|---|---|---|---|
| | 2014-15 | 2015-16 | 2016-17 | Pooled |
| $T_o$ = Control | 2.952 | 3.119 | 2.027 | 2.699 |
| $T_1$ = Water spray | 3.090 | 3.139 | 2.209 | 2.813 |
| $T_2$ = SA (100 ppm) | 3.337 | 3.563 | 2.497 | 3.133 |
| $T_3$ = TGA (100 ppm) | 3.288 | 3.460 | 2.316 | 3.021 |
| $T_4$ = MOP (0.5%) | 3.636 | 3.520 | 2.458 | 3.205 |
| $T_5$ = CN (0.2%) | 3.224 | 3.473 | 2.628 | 3.108 |
| $T_6$ = Brassinolide (5 ppm) | 3.195 | 3.493 | 2.367 | 3.018 |
| $T_7$ = NAA (40 ppm) | 3.062 | 3.628 | 2.615 | 3.102 |
| $T_8$ = Thiourea (500 ppm) | 3.645 | 3.667 | 2.763 | 3.358 |
| S.Em | 0.091 | 0.005 | 0.083 | 0.033 |
| CD@5% | 0.273 | 0.017 | 0.248 | 0.099 |
| CV % | 4.816 | 0.297 | 5.898 | 1.907 |

## 2. Moisture content (%)

A perusal of data in table no 2 indicated that moisture content (%) in durum wheat leaf after second spray analysis for three years and in pooled indicated that thiourea 500 ppm treatment eight gave significantly higher values in individuals years 76.95% , 73.13%, and 66.38% respectively, and pooled analysis also (72.15% ) over the control. Treatment $T_2$ (SA 100 ppm) & $T_6$ (Brassinolide 5 ppm) found statically higher over control. Whereas $T_7$ found at par with $T_2$ & $T_6$. Foliar applications of brassinosteroid (0.5 ppm) solution at tillering stage followed by thiourea (1000 ppm) solution at heading stage and soil application of zinc sulphate (20 kg /ha) in addition to recommended dose of N120, P40 kg/ha proved to be feasible technique for enhancing wheat productivity on farmers' fields (Ola *et al.*, 2016) [9].

**Table 2:** Effect of chemicals and PGRs on moisture content (%) 2nd sampling under conserved moisture condition of durum wheat

| Treatments | Years | | | |
|---|---|---|---|---|
| | 2014-15 | 2015-16 | 2016-17 | Pooled |
| $T_o$ = Control | 68.393 | 68.40 | 62.110 | 66.301 |
| $T_1$ = Water spray | 72.912 | 68.63 | 62.320 | 67.954 |
| $T_2$ = SA (100 ppm) | 73.894 | 69.57 | 64.283 | 69.250 |
| $T_3$ = TGA (100 ppm) | 73.229 | 69.25 | 62.463 | 68.313 |
| $T_4$ = MOP (0.5%) | 73.987 | 70.21 | 64.220 | 69.472 |
| $T_5$ = CN (0.2%) | 74.162 | 70.09 | 64.863 | 69.705 |
| $T_6$ = Brassinolide (5 ppm) | 71.116 | 71.59 | 64.077 | 68.926 |
| $T_7$ = NAA (40 ppm) | 74.782 | 72.41 | 64.250 | 70.480 |
| $T_8$ = Thiourea (500 ppm) | 76.950 | 73.13 | 66.383 | 72.156 |
| S.Em | 0.981 | 0.491 | 0.690 | 0.565 |
| CD@5% | 2.940 | 1.459 | 2.070 | 1.6791 |
| CV % | 2.318 | 1.409 | 1.871 | 1.415 |

## 3. Relative water content (%)

Data revealed that (table 3) significantly higher values of Relative water content (%) was observed in $T_8$ (Thiourea 500 ppm) foliar spray over the control in 2nd sampling ananlysis in individual year 2014-15, 2015-16 & 2016-17 and in pooled analysis and found at par $T_7$ (NAA 40 ppm) in pooled analysis because thiourea has have a role in improving photosynthetic efficiency and translocation of photosynthates (Sahu *et al.*, 1993) [13]. It had a significant role in improving dry matter partitioning towards sink in wheat and enhanced metabolic transport of sucrose to the grain via effect on phloem loading. It has been reported to be effective for enhancing wheat productivity under different environmental conditions (Sahu and Singh, 1995) [14].

Pooja & Sharma (2016) [11] reported that crops showed decrease in RWC under stress conditions. But the application of SA and TU maintained the hydration of cells up to an optimal level, under stress conditions, through accumulation of osmolytes, which sustained water uptake and increased RWC of tissues.

**Table 3:** Effect of chemicals and PGRs on RWC (%) 2nd sampling under conserved moisture condition of durum wheat

| Treatments | Years | | | |
|---|---|---|---|---|
| | 2014-15 | 2015-16 | 2016-17 | Pooled |
| $T_o$ = Control | 80.70 | 61.93 | 65.10 | 69.24 |
| $T_1$ = Water spray | 81.13 | 68.83 | 68.12 | 72.69 |
| $T_2$ = SA (100 ppm) | 86.27 | 69.03 | 71.35 | 75.55 |
| $T_3$ = TGA (100 ppm) | 82.50 | 65.90 | 66.87 | 71.76 |
| $T_4$ = MOP (0.5%) | 83.03 | 68.87 | 71.15 | 74.35 |
| $T_5$ = CN (0.2%) | 83.73 | 70.60 | 69.46 | 74.60 |
| $T_6$ = Brassinolide (5 ppm) | 82.93 | 71.53 | 71.69 | 75.38 |
| $T_7$ = NAA (40 ppm) | 83.80 | 72.30 | 77.69 | 77.93 |
| $T_8$ = Thiourea (500 ppm) | 90.07 | 76.60 | 78.45 | 81.71 |
| S.Em | 0.029 | 0.166 | 1.857 | 1.058 |
| CD@5% | 0.087 | 0.049 | 5.171 | 3.144 |
| CV % | 5.989 | 4.153 | 4.524 | 2.450 |

## 4. Antioxidant activities (%)

Data in table - 4 showed Antioxidant activities (AOA %) was found significantly higher with $T_8$ treatment in pooled (2.27) analysis of three years over the control and also in individual years 2014-15 (2.34), 2015-16 (2.27) and 2016-17 (2.23) respectively, over the control and in 2014-15 $T_8$ treatment found at par with treatment $T_3$ ( TGA 100 ppm). Solanki (2002) [17] reported that thiourea being a sulphydryl compound significantly improved the root growth. This might be due to metabolic role of –SH group in root physiology and biochemistry. Asthir *et al.*, (2016) [3] reported that the thiourea application on wheat ameliorated the heat-induced damages by stimulating the total antioxidant activity through decrease in lipid peroxidation and membrane injury. Foliar spray of thiourea ($C_3$) @ 1000 ppm provide more opportunity time to the crop for its photosynthetic activities and translocation of photosynthates from source to sink which might be subsequently converted to higher yield of durum wheat (Choudhary *et al.*, 2021) [12]

**Table 4:** Effect of chemicals and PGRs on AOA (%) 2nd sampling under conserved moisture condition of durum wheat

| Treatments | Years | | | |
|---|---|---|---|---|
| | 2014-15 | 2015-16 | 2016-17 | Pooled |
| $T_o$ = Control | 1.638 | 1.477 | 1.441 | 1.519 |
| $T_1$ = Water spray | 1.979 | 1.773 | 1.635 | 1.796 |
| $T_2$ = SA (100 ppm) | 2.228 | 1.833 | 1.785 | 1.949 |
| $T_3$ = TGA (100 ppm) | 2.310 | 1.932 | 1.947 | 2.063 |
| $T_4$ = MOP (0.5%) | 2.063 | 2.159 | 2.179 | 2.134 |
| $T_5$ = CN (0.2%) | 2.073 | 2.095 | 2.111 | 2.093 |
| $T_6$ = Brassinolide (5 ppm) | 2.220 | 2.044 | 1.847 | 2.037 |
| $T_7$ = NAA (40 ppm) | 2.020 | 2.146 | 2.082 | 2.083 |
| $T_8$ = Thiourea (500 ppm) | 2.364 | 2.227 | 2.223 | 2.271 |
| S.Em | 0.063 | 0.062 | 0.032 | 0.019 |
| CD@5% | 0.190 | 0.186 | 0.097 | 0.056 |
| CV % | 5.214 | 5.547 | 2.970 | 1.658 |

**5. Proline content (mg/100 g)**

It is clearly evident from the data that presented in table no 5 foliar spray had marked influence on Proline content (mg/100 g) during all the three years and in pooled data. Foliar spray thiourea 500 ppm ($T_8$) recorded significantly maximum value of proline content in separate years and in pooled analysis 32.11, 33.23, 33.35, & 32.96, respectively, over the control which is reduced the heat stress and increase the grain yield of wheat. However, treatment $T_2$, $T_3$, $T_4$ and $T_6$ found at par each other but significantly higher than control. Many studies have shown positive effect of proline on plant metabolism and its protective role from abiotic stress in different plant spaces (Verbruggen and Hermans, 2008) [19]. Proline also represents a lipid peroxidation inhibitor (Jain *et al*., 2001) [6]. Wahid *et al*. (2007) [20] has shown that as a result of heat stress, proline accumulation occurs as a protective mechanism in plants. Iqbal *et al.*, (2013) [5] reported that seed treatment with salicylic acid 0.5 mM (SA) interacts with proline metabolism and ethylene formation to alleviate the adverse effects of heat stress on photosynthesis in wheat.

**Table 5:** Effect of chemicals and PGRs on proline content (mg/100 g) 2nd sampling under conserved moisture condition of durum wheat

| Treatments | Years | | | |
|---|---|---|---|---|
| | 2014-15 | 2015-16 | 2016-17 | Pooled |
| $T_o$ = Control | 18.10 | 17.39 | 17.78 | 17.76 |
| $T_1$ = Water spray | 19.03 | 21.41 | 21.72 | 20.72 |
| $T_2$ = SA (100 ppm) | 20.34 | 23.48 | 32.33 | 25.38 |
| $T_3$ = TGA (100 ppm) | 29.32 | 24.09 | 22.46 | 25.29 |
| $T_4$ = MOP (0.5%) | 19.09 | 27.67 | 31.83 | 26.20 |
| $T_5$ = CN (0.2%) | 19.22 | 21.40 | 23.90 | 21.51 |
| $T_6$ = Brassinolide (5 ppm) | 22.56 | 32.05 | 21.78 | 25.46 |
| $T_7$ = NAA (40 ppm) | 20.66 | 32.28 | 24.47 | 25.80 |
| $T_8$ = Thiourea (500 ppm) | 32.11 | 33.23 | 33.55 | 32.96 |
| S.Em | 1.298 | 0.975 | 0.596 | 0.541 |
| CD @ 5% | 3.892 | 2.896 | 1.772 | 1.609 |
| CV % | 10.097 | 6.532 | 4.048 | 3.280 |

**Conclusion**

On the basis of aforesaid findings, it could be concluded that the successive foliar spray of thiourea 500 ppm at ($T_8$) in durum wheat at crop growth stage tillering and ear emergence mitigating the adverse effect of drought stress in rained conditaion and gave significantly higher values of, chlorophyll content (mg/fresh weight) 3.358, moisture content (%) 72.16, relative water content (%) 81.71, antioxidant activities (%) 2.271 and proline content (mg/100 g) 32.96. However, treatment $T_2$ (SA 100 ppm), $T_3$ (TGA 100 ppm), and $T_6$ (Brassinolide 5 ppm) also found to be effective in mitigating the stress in durum wheat under conserved soil moisture condition

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