Int. J. Agricult. Stat. Sci. Vol. 16, Supplement 1, pp....., 2020 ISSN : 0973-1903

ORIGINAL ARTICLE

RESPONSE OF WHEAT (*Triticum aestivum* L.) TO SPERMIDINE AT DIVERGENT DEVELOPMENTAL PHASES OF GROWTH

Sabeeha H. Kadhim

AL-Musaib Technical College, Al-Furat Al-Awsat Technical University, Babylon, Iraq.
E-mail : com.sabh@atu.edu.iq

Abstract : The effect of spermidine concentration (0,1, 2, mM/L) and phases of spraying (Tillering, Boating, Anthesis and Filling Stage) on yield and its components of wheat (*Triticum aestivum* L.) were investigated in a factorial in RCBD experiment with three replicates in 2018-2019 season in Babylon/Iraq. The outcomes of this work show that spermidine in S1 mM/L increased significantly yield and its components. Same trend was observed with the treatment in filling stage (G4). The interaction between (S1xG4) at the above mentioned levels of the two factors also boosted significantly yield and its components.

Key words : Wheat, Spermidine, Yield and its components.

1. Introduction

Yield and its components of wheat (*Triticum aestivum* L.) can pass through many stages (Anthesis, Filling and Maturation), while yield potential can be expressed as number of spikes per plant, grain number per spike and grain weight [Yang and Zhang (2006)]. Improving yield of wheat and its components require factors that triggers growth and development of grain. Wheat is one of a most and vital important crops of nutritional value around the world due to its high content of carbohydrates, protein, minerals, vitamins. Also it is a main component of food of mostly all mankinds around the globe. In Iraq, wheat possesses a great deal of importance in the list of consuming materials and can fulfil the increasing demand of food and local consumption. Polyamines are present in mostly all members of plant kingdom and in different plant cells, and due to its improving effect on yield and plant growth and development [Igarashi and Kashiwagi (2000), Akazar *et al.* (2006)]. Polyamines are considered as a new class of growth substances [Marwa and Mervat (2016)]. Polyamines reported to be triggering signals affecting plant and cell growth in various stages of developmental stages. Polyamines occurring in plant cells in different criterions, yet, putrescine, spermidine and spermin are the main classes of them because of their widely spread in the tissues of the plants. Yang *et al.* (2013) found that polyamines increased significantly grain yield of wheat. They also reported that polyamines promoted grain filling rates and ultimately augmented significantly spike weight and grain yield and thereby increasing wheat productivity. Yang *et al.* (2016) stated the same trend of effect of polyamines on increasing yield and its components of wheat. Yang *et al.* (2007) also reported that polyamines promote grain filling rates and boosts grain weight of rice. In the present experiment IPA 99 wheat cultivar was treated with different levels of spermidine in different stages of grain development to assess its impact on grain filling characteristics and finally on yield and its components.

2. Materials and Methods

A field factorial experiment to investigate the effect of spermidine on yield and its components of wheat (*Triticum aestivum* L.) (IPA99 var.) was conducted in winter seasons of 2018 and 2019 in Musaib, Babylon. Spermidine (0,1,2 mM/L) (S0, S1 and S2) was sprayed in four stages (Tillering, Boating, Anthesis and Filling

Received February 16, 2020 *Revised July 08, 2020* *Accepted August 02, 2020*

pp: 1217 – 1220

Stage), in 3 replicates. Soil chemical and physical properties were determined before starting the study of agronomical practices. Irrigation, watering, insect and pest control were done accordingly.

3. Results

The spermidine has a definite impact on spike number (Table 1). S2, however, gave the highest mean of this trait (424.95) and (419.10) spike/m^2, for 2018 and 2019 respectively, as compared to the control that recorded (378.81 and 387.80) spike/m^2 for the two seasons respectively. It is worth to say that S2 is not significantly different from S1 treatment. G4 treatment, on the other hand resulted in higher mean of this trait (426.23 and 424.20) spike/m^2 for the two seasons, with a significant difference with the rest treatments.

The interaction of S1 × G4 gave the highest mean of spike/m^2 as compared to the other interactions.

In Table 2, the effect of the study factors on spikelet/spike are shown. From the data given in this table it could be said that S1 significantly increased the spikelet/ spike and recorded (38.03 and 38.18) spikelet/ spike for the two seasons, respectively. As for the stage of spraying, therefore, G4 increased significantly the mean (37.26, 37.29 spikelet/spike) for the two seasons, respectively. S1 × G4 interaction treatment recorded the higher mean of this quality (38.62, 38.88)

Table 1 : Effect of spermidine concentrations on spike no/ m^2 of growth stages of wheat (*Triticum aestivum* L.).

(2018)

S \ G	G1	G2	G3	G4	Mean
S0	373.13	374.73	384.10	383.26	378.81
S1	405.10	404.83	416.16	463.03	422.28
S2	427.50	410.33	429.60	432.40	424.95
Mean	401.91	396.63	409.95	426.23	
L.S.D.S = 4.80		L.S.D.G= 5.54		L.S.D.S x G = 9.60	

(2019)

S \ G	G1	G2	G3	G4	Mean
S0	377.40	387.70	388.30	398.10	387.80
S1	410.20	409.90	416.50	453.10	422.40
S2	435.30	408.30	411.40	421.40	419.10
Mean	407.60	401.90	405.40	424.20	
L.S.D.S = 4.85		L.S.D.G= 5.61		L.S.D.S x G = 9.71	

Table 2 : Effect of spermidine concentrations on spikelets no/spike of growth stages of wheat (*Triticum aestivum* L.).

(2018)

S \ G	G1	G2	G3	G4	Mean
S0	34.81	35.53	36.42	36.47	35.80
S1	37.83	37.81	37.87	38.62	38.03
S2	37.41	36.23	36.65	36.71	36.75
Mean	36.68	36.52	36.98	37.26	
L.S.D.S = 0.21		L.S.D.G= 0.25		L.S.D.S x G = 0.43	

(2019)

S \ G	G1	G2	G3	G4	Mean
S0	34.23	34.89	35.82	36.20	35.29
S1	37.91	37.91	38.04	38.88	38.18
S2	37.41	36.45	36.64	36.80	36.82
Mean	36.51	36.41	36.83	37.29	
L.S.D.S = 0.21		L.S.D.G= 0.25		L.S.D.S x G = 0.43	

spikelet/spike for the two seasons, respectively.

Results regarding grain weight (gm) were put in Table 3. S2 augmented significantly the grain weight (40.98) and 41.24 gm) for the two seasons respectively with no significant difference with S1 only, that recorded

Table 3 : Effect of spermidine concentrations on grain weight/gm of growth stages of wheat (*Triticum aestivum* L.).

(2018)

S \ G	G1	G2	G3	G4	Mean
S0	33.53	33.67	34.46	34.70	34.09
S1	35.81	35.91	40.37	44.91	39.25
S2	42.63	40.40	40.44	40.46	40.98
Mean	37.32	36.66	38.42	40.02	
L.S.D.S = 0.36		L.S.D.G= 0.42		L.S.D.S x G = 0.72	

(2019)

S \ G	G1	G2	G3	G4	Mean
S0	33.10	33.86	37.50	34.87	34.83
S1	35.57	36.06	40.61	44.52	39.19
S2	42.71	41.04	40.52	40.71	41.24
Mean	37.12	36.98	39.54	40.03	
L.S.D.S = 1.43		L.S.D.G= 1.65		L.S.D.S x G = 2.86	

(39.25, 39.19 gm) for the study seasons respectively. Regarding application stages. Thus, G4 gave the highest mean (40.02, 40.03 gm.) respectively as compared to the other stages.

Interaction between G4 and S1 treatments recorded higher mean of the trait under study (44.91, 44.2 gm.) for the two seasons respectively with high significant difference with the other interaction treatments.

As compared to all treatments S2 and S1 of 2018 and 2019 respectively resulted in a significant differences in the mean of grain yield (ton/hec) (5.89) for S2 in 2018 and 5.77 for S1in 2019 (Table 4). Yet, no significant difference is there between S1 and S2 for 2019.

The higher mean of grain yield (ton/hec) was recorded in G4 (Table 4). It gave 5.61, 5.64 ton/hec for the two seasons, respectively. 6.35 and 6.37 ton/hec were the means of S1 × G4 nteraction treatment for the two seasons respectively in comparing with the other interactions.

4. Discussion

Table 4 : Effect of spermidine concentrations on grain yield ton/hec of growth stages of wheat (*Triticum aestivum* L.).

(2018)

S \ G	G1	G2	G3	G4	Mean
S0	4.34	4.48	4.50	4.70	4.51
S1	5.00	5.42	6.07	6.35	5.71
S2	5.57	5.36	5.65	5.77	5.89
Mean	4.97	5.09	5.41	5.61	
L.S.D.S = 0.12		L.S.D.G= 0.14		L.S.D.S x G = 0.24	

(2019)

S \ G	G1	G2	G3	G4	Mean
S0	4.56	4.56	4.63	4.76	4.63
S1	5.06	5.48	6.15	6.37	5.77
S2	5.65	5.55	5.61	5.80	5.65
Mean	5.09	5.19	5.46	5.64	
L.S.D.S = 0.10		L.S.D.G= 0.12		L.S.D.S x G = 0.20	

Polyamines are a class of natural occurring substances present in most of plants [Gill and Tuteja (2010] and have been involved in the various plant growth and development processes [Unsal (1995)]. Polyamines have been found to mitigate the badly effect of bad conditions and improve plant responses for many kinds of stress [Duan *et al.* (2009)]. Polyamines were recognized to be one of the plant regulators [Xu *et al.* (2014)]. The influence of polyamines on wheat growth, productivity was investigated. The effect of polyamines on photosynthetic pigments was also studied besides their effect on many growth traits such as leaf area, shoot length, dry matter, yield and yield components in various members of plant kingdom. Chlorophyll content of leaf was shown to be increased by exogenes application of polyamines [Gai *et al.* (2015)]. Polyamines foliar application resulted in wide responses of plants. They increase and enhance cell division and leaf area [Yadov and Rajam (1997)], shoot length and also stimulate many processes of plant cells such as photosynthesis and increased the different photosynthetic products of the wheat plant [Gai *et al.* (2015)]. Polyamines have also bio regulatory effect through increasing the rate of dry matter translocation leading to increase in spike dry matter, and therefore, improved yield and yield components [Marwa *et al.* (2016)]. Grain filling process in wheat strongly affects the yield by triggering grain weight and is an important quality for assessing wheat productivity. Polyamines were believed to be a factor manipulates and regulates grain filling in rice. The spermidine concentrations in superior grain were significantly higher than in inferior grains. The grain filling rate of rice was strongly related with the spermidine concentration in the grain [Yang *et al.* (2008)]. In my study, results proved that exogenous application of spermidine to wheat plant caused a marked increase in yield (Table 4) and yield components (Tables 1, 2, 3). On the other hand, the concentration (1m *M*) gave the highest means of the above parameters. It is also clear from the data of this research that using spermidine at the filling stage of wheat grain resulted in the higher yield and yield components. Also from other perspective that their interaction has also positive effect the traits studied. It could be concluded that the present results of the two factors can be attributed to the reasons given above in this discussion. It could be finally and strongly said that polyamines create a firm and efficient relation between the main source of the plant (Leaf) and the main sink (Grain during Filling Stage) of the wheat grain and finally could increase grain filling rate and grain

weight and thereby increases yield and its components. Therefore, it could be concluded that for high yield of wheat spraying spermidine at 1.0 mM/L during filling stage of grain development.

References

Akazar, R., Marco F. Cuevas Jc and Patron M. Ferrando A (2006). Involvement of polyamines in plant 1867-1876.

Cai, G., E. Sobiezcczuknowicka, I. Aloisi and E. Al (2015). Polyamines are common players in different facets of plant programmed cell death. *Amino Acids*, 47, 27-44. Doi: 10.1007 / s00726 – 014 – 1865 -.

Duan, J.J., J. Li, S.R. Guo and Y.Y. Kang (2009). Exogenous spermidine affects polyamine metabolism in salinity-stressed *Cucumis sativus* roots and enhances short-term salinity tolerance. *J Plant Physiol.*, 165, 1620-16 35.

Gill, S. and N. Tuteja (2010). Polyamines and abiotic stress tolerance in plants. *Plant Singaling and Behavior J.*, 5(1), 26-33.

Igarashi, K. and K. Kashiwagi (2000). Polyamines: mysterious modulators of cellular functions. *Biochem. Biophys. Res. Commun.*, 271, 559-564.

Marwa, M.R., M. Ahmed and Mervat Sh. Sadak (2016). Effect of putrescine Foliar application on wheat Genotypes (*Triticum aestivum* L.) under water stress conditions. *International Journal of Pharm Tech Research*, 9(8), 94-102.

Unsal N (1995). Stress and polyamines metabolism. *Bulg. J. Plant Physiol.*, 21(2-3), 3-14.

Xu, D., J. Guo and L. Xu (2014). The relationship between polyamine oxidase activity and lignin deposition and chrysanthemum flower bud differentiation. *Acta Agric. Boreali Sinica*, 29,164-169.Doi:10.7668/ hbnxb.2014.03.030

Yadov, J.S. and M.V. Rajam (1997). Spatial distribution of free and conjugated polyamines in leaves of *Solanum melongena* L. associated with differential morphogenetic capacity : efficient somatic embryogenesis with putrescine. *J. Exp. Bot.*, 48, 1537-1545. Doi:10.1093/jxb/48.8.1537.

Yang, J.C. and J.T.I. Zhang (2006). Grain filling of cereals under soil drying. *New Phytol.*, 169, 223-236.

Yang, J.C., J.H. Zhang, K. Liu, Z.O. Wang and Liu (2007). Involvement of polyamines in the drought resistance of rice. *J. Exp. Bot.*, 58(6), 1545-1555.

Yang, J.C., Y.Y. Cao, H. Zhang, L.J. Liu and J.H. Zhang (2008). Involvement of polyamines in the post anthesis development of inferior and superior spikelets in rice. *Planta*, 228, 137-149.

Yang, Liu, G. Dandan, Wei Wu, Xiaoxia Wen and Yuncheng Liao (2013). The relationship between polyamines and Hormones in the Regulation of wheat Grain Filling. *Plos One*, 8(10), e78196

Yang, Liu, Haiyam Hiang, Xiaokang Lv, Didi Liu, Xiaoxia Wen and Yunchang Liao (2016). Effect of polyamines on the grain filling of wheat under drought stress. *Plant Physiology and Biochemistry*, 100, 113-129.