International Journal of Environment and Climate Change

Volume 13, Issue 10, Page 4031-4037, 2023; Article no.IJECC.106003
ISSN: 2581-8627
(Past name: British Journal of Environment & Climate Change, Past ISSN: 2231–4784)

Potential of Zinc Glycinate and Calcium Chloride on Morphological and Yield Characters of Wheat (*Triticum aestivum* L)

Porakala Vineeth Kumar [a,b++*], Bineeta M. Bara [a,b#] and G. Roopa Lavanya [a,b†]

[a] Department of Genetics and Plant Breeding, SHUATS, Prayagraj, India.
[b] Department of Genetics and Plant Breeding, Faculty of Agriculture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj-211007, Uttar Pradesh, India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJECC/2023/v13i103079

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/106003

Original Research Article

Received: 09/07/2023
Accepted: 13/09/2023
Published: 25/09/2023

ABSTRACT

The present study entitled "Potential of Zinc glycinate and Calcium chloride on morphological and yield characters of Wheat *(Triticum aestivum* L*)*" was carried out to assess the effectof seed treatments during 2022-2023 to find the suitable seed treatment for wheat. Thirteen treatments

[++] M.Sc. Scholar;
[#] Assistant Professor;
[†] Professor;
**Corresponding author: E-mail: vineethgoud396@gmail.com;*

along with control consists of Calcium chloride, Zinc glycinate and Calcium chloride & Zinc Glycinate in different concentrations, individually and combination as well. A Randomized Block Design (RBD) was used for statistical analysis. The main objectives of this experiment was to evaluate the influence of different concentrations of Zinc glycinate and Calcium chloride on morphological and yield parameters of Wheat and to determine the effective treatment for wheat. The results indicated that all treatments recorded significant variation for pre-harvest and post-harvest parameters that were studied. The treatment T_{12} (Calcium chloride + Zinc glycinate-7%+7%) significantly recorded the higher values in Field emergence(95.55%), Plant height(93.13 cm), Number of tillers per plant(5.73), Spike length(15.18 cm), Seed yield per plant(16.37g) and Harvest Index(40.09%), in comparision with other treatments and lowest recorded in T0(control). This study helps to find the best suitable seed treatment for wheat.

Keywords: Seed treatment; zinc glycinate; $CaCl_2$; field emergence; harvest index.

1. INTRODUCTION

Common wheat or Bread wheat (*Triticum aestivum* L) is most widely grown type wheat in India. It is a good source of carbohydrates, dietary fiber and essential nutrients such as Vitamin B and minerals like Iron and Magnesium but relatively low in certain amino acids such as Lysine and Protein sources. Wheat is used as a primary ingredient in a wide range of floods. It can be ground into flour to make products like Bread, Pastries, Cakes and Pasta. Wheat is best adapted to temperate regions with rainfall 30 cm to 90 cm. In 2022, world wheat production was 761 million tonnes, led by China, India, and Russia collectively providing 38% of the world total (International wheat production statistics, 2022). As per Second Advance Estimates for the agriculture year 2022-23, the wheat production in India is estimated at 112.18 million tons which is higher by 4.44 million tonnes than the production achieved during 2021- 22. The total sown area under the wheat crop was 34.3 million hectares as of 2023. Wheat production in Uttar Pradesh is estimated at 9590.00 ha for the year 2022-23. (Ministry of Agriculture and Farmers Welfare, 2022-23). It has a good nutritional profile with 13% proteins, 40% Wet gluten content, 7% Yellow pigment content, 7% pentosans, 1.8% lipids. 1.8% ash. 20% reducing sugars and provides 314 Kcal/100g of food [4]. Besides it also contains Calcium (37 mg/100 g), Nicotinic acid (5.4 mg/100 mg), Iron (4.1 mg/100 g), Thiamine (0.45 mg/100 g) and Riboflavin (Fernando, 2014).

Pre-sowing seed treatment refers to that treatments that are applied to seeds before they are planted in order to enhance their germination, growth and overall health to improve the crop establishment and yield potential [2,3]. Some of that treatments are Zinc glycinate and Calcium chloride. Zinc glycinate is a chelated form of zinc, where zinc is bound to the amino acid glycine. In plants, zinc is an essential micronutrient that plays a vital role in various physiological processes and is required for proper growth, development, and overall health. Calcium chloride ($CaCl_2$) is a salt of calcium and chlorine and is widely used in various agricultural and horticultural practices as a source of calcium and as a means to manage specific plant responses. Calcium is one of the essential secondary nutrients required by plants. Through the pre-sowing treatment in the seed, one can enhance the quality of seeds [8,9]. The seed can protect the stress which is caused by the abiotic stress and also produce equal germination, thus overall crop yields might be greatly enhanced [13-16]. It is also reported that seed hardening can be useful to develop the rapid and uniform germination and emergence of the seeds and it also increases the seeds tolerance to adverse environmental conditions [1].

2. MATERIALS AND METHODS

2.1 Description of Experimental Site

This experiment was conducted in Rabi season of 2022 in field experimentation of Department of Genetics and Plant Breeding, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (25 24' N, 810 51' E). The soil was of sandy clay loam in texture, p^H of water is 7.1, Organic matter (0.50%) and Electrical conductivity (0.37 dsm^{-1}). The experimental material for present investigation comprised of 13 treatments was conducted in Randomized Block Design (RBD) with 3 Replications.

2.2 Preparation of Treatments with Zinc Glycinate

Seeds were soaked in four concentrations of Zinc Glycinate; 1% solution was prepared by dissolving 1 gram in 100 ml of distilled water. 2%, 5% and 7% solutions were prepared by dissolving 2 grams, 5 grams and 7 grams in 100 ml of distilled water respectively. The seeds were soaked for 3 hours and then it is allowed to dried under shade condition for a period of 3 hours and finally it dried under sun condition which bring back to its original moisture condition.

2.3 Preparation of Treatments with Calcium Chloride

Seeds were soaked in four concentrations of Calcium chloride; 1% solution was prepared by dissolving 1 gram in 100 ml of distilled water. 2%, 5% and 7% solutions were prepared by dissolving 2 grams, 5 grams and 7 grams in 100 ml of distilled water respectively. The seeds were soaked for 3 hours and then it is allowed to dried under shade condition for a period of 3 hours and finally it dried under sun condition which bring back to its original moisture condition.

The following are the treatments:

T_0-Control
T_1-Calcium chloride (1%)-3 hours
T_2-Calcium chloride(2%)-3 hours
T_3-Calcium chloride(5%)-3 hours
T_4-Calcium chloride(7%)-3 hours T_5-Zinc glycinate(1%)-3 hours
T_6-Zinc glycinate(2%)-3 hours
T_7-Zinc glycinate(5%)-3 hours
T_8-Zinc glycinate(7%)-3 hours
T_9-Calciumchloride+Zinc glycinate(1% + 1%) -3 hours
T_{10}-Calciumchloride+Zinc glycinate (2% + 2%)-3 hours
T_{11}-Calciumchloride+Zinc glycinate(5% + 5%)-3 hours
T_{12}-Calciumchloride+Zinc glycinate (7% + 7%)-3 hours

2.4 Seed Sowing and Cultural Practices

Wheat variety AAIW-42 seeds were provided by Department of Genetics and Plant Breeding, Naini Agricultural institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (Uttar Pradesh) India. Seeds were sown in soil at the depth of 3-5 cm with spacing of 30× 10 cm^2 @ 100 kg/ha. Total 30 seeds were sown per treatment in 3 lines in each replication. Irrigation given weekly basis in such a way that the moisture content remained > 80% and 3 hoeing were given to keep plots free from

Fig. 1. Pre-sowing seed treatment with different concentrations of Calcium chloride and Zinc glycinate

weeds. Individual treatments were harvested with the help of sickles and threshed to separate the seeds. Wheat crop taken 110 days for harvesting from 25 November 2022 to 15 March 2023. In the present study, data of the following pre-harvest and post- harvest parameters data is recorded:

1. Field Emergence (%).
2. Plant height(cm).
3. Number of tillers per plant.
4. Days to 50% flowering.
5. Spike length(cm).
6. Days to Maturity.
7. Seed yield per plant(g).
8. Harvest index (%).

3. RESULTS AND DISCUSSION

Results from the experiment revealed that different concentrations of pre-sowing seed treatment influenced the growth and yield parameters. The present study revealed that treatment T_{12}- Calcium chloride(7%) along with Zinc glycinate(7%) showed that maximum growth and yield attributing traits in Wheat. The mean values, standard error mean, standard error of difference, the critical difference at 5 % level of significance and coefficient of variation with 13 treatments along with 8 parameters where represented in Table-1, which revealed a wide range of variation for all the traits studied. The mean performances of different priming treatments with respect to different attributes is described as under:

3.1 Morphological Attributes

As per the data mentioned in the Table-1. the maximum field emergence was found in treatment T_{12}- Calcium chloride 7% and Zinc glycinate 7% with mean value of 95.55% which is followed by treatment T_{11}- Calcium chloride 5% and Zinc glycinate 5% with mean value of 94.44% and minimum was observed in control treatment with mean value of 84.44% [7]. Calcium and Zinc treated seeds withstand the stress which is caused by the abiotic stress and also produce equal germination, useful to develop the rapid and uniform germination and emergence of the seedlings [1,10-12]. Maximum plant height after 90 days in wheat was observed in the treatment T_{12}- Calcium chloride 7% and Zinc glycinate 7% with mean value of 93.13 cm which is followed by T_{11}- Calcium chloride 5% and Zinc glycinate 5% with mean value of 92.34 cm and minimum was observed in control treatment with mean value of 85.04 cm [20]. Calcium chloride ($CaCl_2$) plays a crucial role in maintaining plant cell structure and its function. It is an integral component of the middle lamella, which holds plant cell walls together, providing strength and rigidity to the plant's tissues that increases the plant height rapidly [1]. Maximum number of tillers were found in treatment T_{12}- Calcium chloride 7% and Zinc glycinate 7% with mean value of 5.73 which is followed by T_{11}- Calcium chloride 5% and Zinc glycinate 5% with mean value of 5.46 and minimum was observed in control treatment with mean value of 4. As per the data shown in the Table-1 minimum days required for 50 % flowering were observed in treatment T_{12}- Calcium chloride 7% and Zinc glycinate 7% with mean value of 65 days which is followed by T_{11}- Calcium chloride 5% and Zinc glycinate 5% with mean value of 67 days but control treatments takes 75 days for 50 % flowering which is highest when compared with other treatments. Zinc is an essential micronutrient that plays a vital role in various physiological processes and is required for proper growth and causes for early flowering in wheat. Maximum spike length was observed in treatment T_{12}-Calcium chloride 7% and Zinc glycinate 7% with mean value of 15.18 cm which is followed by T_{11}- Calcium chloride 5% and Zinc glycinate 5% with mean value of 14.76 cm and minimum was observed in control treatment with mean value of 11.27 cm. As per the data shown in the Table-1 minimum days required for maturity of wheat crop were observed in treatment T_{12}- Calcium chloride 7% and Zinc glycinate 7% with mean value of 110.6 days which is followed by T_{11}- Calcium chloride 5% and Zinc glycinate 5% with mean value of 111.60 days but control treatment takes 121.06 days for maturity which is highest when compared with other treatments. Zinc is a crucial component that enhances various enzymes which play essential roles in various metabolic processes like Auxin (plant growth hormone) synthesis and Carbon metabolism which reduces the maturity time for wheat [17-19].

3.3 Yield Attributes

As per the data shown in the Table-1 maximum seed yield per plant was observed in treatment T_{12}- Calcium chloride 7% and Zinc glycinate 7% with mean value of 16.37 g which is followed by T_{11}- Calcium chloride 5% and Zinc glycinate 5% with mean value of 16.11 g and minimum was observed in control treatment with mean value of

Table 1. The mean values of different pre-sowing seed treatment in wheat

S.No.	Treatments	Field emergence (%)	Plant height (cm)	No.of tillers per plant	Days to 50% flowering	Spike length (cm)	Days to maturity	Seed yield per plant(g)	Harvest index(%)
1	To	84.44	85.04	4.00	75.00	11.27	121.06	13.22	36.66
2	T_1	91.22	87.69	4.20	73.66	12.70	115.53	14.40	39.00
3	T_2	88.88	88.49	4.33	72.33	12.66	114.06	14.46	39.50
4	T_3	93.32	91.88	4.93	69.33	14.36	114.26	15.56	38.74
5	T_4	93.33	91.12	5.06	69.00	14.48	115.26	15.66	39.60
6	T_5	89.99	88.47	4.13	72.66	13.26	115.13	14.61	38.02
7	T_6	88.88	88.68	4.26	74.33	12.86	114.00	14.70	39.61
8	T_7	90.11	88.68	4.13	71.33	12.80	115.06	14.64	40.01
9	T_8	88.88	89.52	4.20	72.00	13.48	114.46	14.64	37.15
10	T_9	88.99	88.07	4.13	72.66	12.58	114.06	14.21	39.16
11	T10	92.22	88.92	4.06	73.66	12.77	113.93	14.82	37.87
12	T11	94.44	92.34	5.46	67.00	14.76	111.66	16.11	39.28
13	T12	95.55	93.13	5.73	65.00	15.18	110.60	16.37	40.09
Grand Mean		90.79	89.38	4.51	1.14	13.38	114.54	14.88	38.82
SE(d)		1.74	1.36	0.23	1.74	0.28	0.83	0.31	0.68
SE(m)		1.23	0.61	0.16	1.23	0.20	0.58	0.21	0.48
C.D(0.05 p)		3.59	1.78	0.48	3.60	0.59	1.71	0.64	1.41
C.V.		2.35	1.18	6.40	2.99	2.66	0.88	2.55	2.16

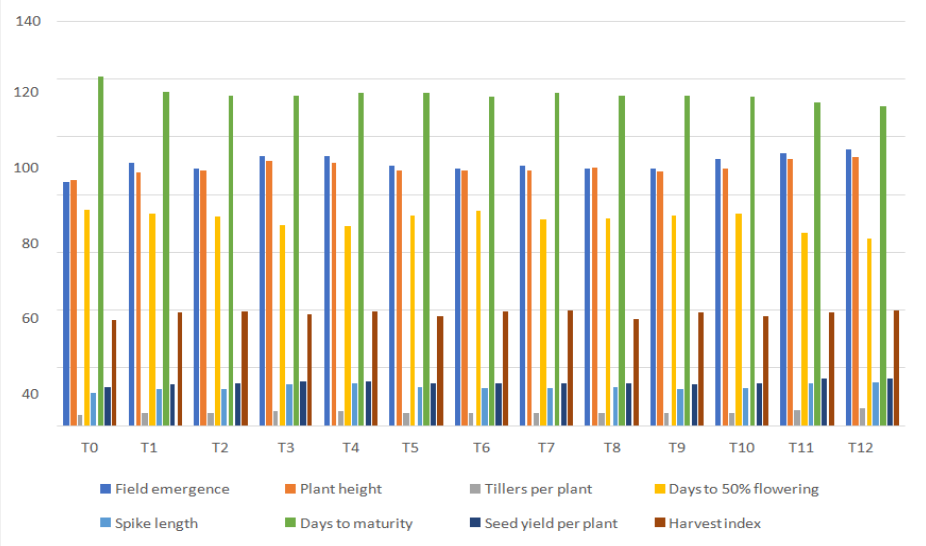

Fig. 2. Bar graph representing the mean values of different presowing seed treatments in Wheat

13.22 g [5,6]. Maximum Harvest index was observed in treatment T_{12}- Calcium chloride 7% and Zinc glycinate 7% with mean value of 40.09% which is followed by T_7-Zinc glycinate(5%) with mean value of 40.01% and minimum was observed in control treatment with mean value of 36.66% [21].

4. CONCLUSION

From the present investigation it is concluded that Calcium chloride and Zinc glycinate that plays a vital role in various physiological processes and is required for proper growth and causes for early flowering and early maturity in wheat. Among the various seed treatments, treatment with Calcium chloride 7% along with Zinc glycinate 7% of 3 hours duration showed significantly maximum in all attributes which is followed by Calcium chloride 5% along with Zinc glycinate 5%. Treatment T_{12} shows highest field emergence(95.55%), plant height(93.13 cm), tillers per plant(5.73), spike length(15.18 cm), seed yield per plant(16.37 g) and harvest index(40.09%) and taken very less time for 50 % flowering and maturity of crop when compared with all other treatments in this experiment. It is concluded that from this experiment Calcium chloride 7% along with Zinc glycinate 7% is better performed seed treatment.

ACKNOWLEDGEMENT

Authors are thankful to all the faculty members of the Department of Genetics and Plant Breeding, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh, India for providing the encouragement and support during experiment.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Ananthi M, Sasthri G, Srimathi P and Malarkodi K. Evaluation of storage potential of pre-sowing seed treatment. Journal of Pharmacognosy and Phytochemistry. 2017;6(3):502-505.
2. Afzal I, Rauf S, Basra S and Murtaza G. Halopriming improves vigor, metabolism of reserves and ionic contents in wheat seedlings under salt stress. Plant soil environment. 2008;54(9):382–388.
3. Anbu S and Maseeha A. Effect of Zinc Glycinate and calcium chloride on seed pre sowing treatment in green gram. International Journal of Research and Analytical Reviews. 2019;6(1).
4. Anvesha. A statistical study of trends of wheat production in districts of Eastern Uttar Pradesh, India. International journal of current microbiology and applied sciences 2020;9(4).
5. Cassyo Araujo Rufino, Lizandro Ciciliano Tavares, Andre Pich Brunes, Elisa Souza

Lemes, Francisco Amaral Villela. Treatment of wheat seed with zinc, fungicide, and polymer: seed quality and yield. Journal of Seed Science. 2007; 35(1):106-112.
6. Chavan NG, Bhujbalg B, Manjare RM. Effect of seed priming on seed performance and seed yield of soybean (*Glycine max*) International Journal of Quarterly Sciences. 2014;9(1):111-114.
7. Dahab. Impact of Seed Priming in salty solutions on germination and seedling vigour of some wheat cultivars under salinity conditions. Journal of Plant Production. 2015;6(3):271-285.
8. Dharminder, Roy DK, Choudhary SK, Rajan Kumar, Kaushal Kishor, Udit Kumar. Role of surface seeding, seed priming and seed rate in accelerating the wheat productivity. Journal of Agricultural Sciences and Technology. 2020;22(3):875-888.
9. Freiberg. Seed treatment and its impact on wheat crop yield potential. Journal of Seed Science. 2017;39(3):280-287.
10. Gholamin. Effects of polyethylene glycol and NaCl stress on two cultivars of wheat (Triticum durum) at germination and early seeding stages. Journal of Agriculture Environmental Sciences. 2010;9(1):86-90.
11. Harris David, Abdul Rashid & Ghazal Miraj & Mohammed Arif & Mohammed Yunas. On-farm seed priming: using participatory methods to revive and refine a key technology. Agricultural Systems. 2001;69: 151-164.
12. Jafar ZM, Farooq M, Cheema MA, Afzal I, Basra S, Wahid MA, Aziz T, Shahid M. Improving the Performance of Wheat by Seed Priming Under Saline Conditions. Journal of Agronomy and Crop Sciences. 2012:09311-2250.
13. Jnana Bharati, Narayan Chandra Sekhar and Jagadish Jena. Effect of Zinc on growth, yield, zinc use efficiency and economics in baby corn**.** Journal of Pharmacognosy and phyto chemistry 2018;2278-4136.
14. Lizandro Ciciliano, Cassyo de Araujo Rufino, Andre Pich Brunes, Felipe Freire Friedrich, Antonio Carlos, Francisco Amaral Villela. Physiological performance of wheat seeds coated with micronutrients. Journal of Seed Science. 2013;35(1):28-34.
15. Maralian Habib. Effect of foliar application of Zn and Fe on wheat yield and quality; 2009. African Journal of Biotechnology 8(24): 6795-6798.
16. Nazia Hassan, Sohail Irshad, Muhammad Sohail Saddiq, Saqib Bashir, Shahbaz Khan, Muhammad Ashfaq Wahid, Rashad Rasool Khan & Munazza Yousra. Potential of zinc seed treatment in improving stand establishment, phenology, yield and grain biofortification of wheat. Journal of plant nutrition. 2017;12:1532-4087.
17. Nouairi, Jalali K, Zribi F, Barhoumi F, Zribi K and Mhadhbi H. Seed priming with calcium chloride improves the photosynthesis performance of Faba bean plants subjected to cadmium stress. Photosynthetica. 2019;57(2):438-445.
18. Sarrocco S and Raeta R. Seeds encapsulation in calcium alginate pellets. Seed Sci. & Technology 2004;32:649-661.
19. Soujanya, Bineeta Michael Bara, Prashant Kumar Rai and Abhishek Kumar Pal. Impact of Salinity on Germination Percentage and Seedling Growth in Sorghum (*Sorghum bicolor* L.) var. CSH – 14. Biological Forum – An International Journal. 2022;14(4):198-202.
20. Victoria. Role of Micro and Macro nutrients in the Growth and Development of the plants. International journal of current microbiology and applied sciences. 2020; 11(9):219-226.
21. Yousof FI. Effect of rice seed priming with calcium chloride ($CaCl_2$) on germination and seedlings vigor under salinity stress. Journal Plant Production. 2013;4(4):523–535.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/106003