

Original Research Article

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Studies of Foliar Nutrients on Productivity and Quality of Wheat Seed (*Triticum aestivum* L.) under Lower Gangetic Alluvial Soils of West Bengal, India

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A B S T R A C T

A field experiment was conducted at Agricultural Experimental Farm of Calcutta University, Baruipur, South 24 – Parganas, West Bengal during the during *rabi* season of 2016 – 2017 on Gangetic Alluvial Soil. The investigation was designed to study “Studies of foliar nutrients on productivity and quality of wheat (*Triticum aestivum* L.) seed under lower Gangetic alluvial soils of West Bengal”. This investigation was laid out in a Randomized block design with three replications on the Gangetic alluvial soil of lowland under well irrigated condition. There were altogether 10 treatments of supplementary foliar nutrients viz. KCl @ 0.75%; KNO₃ @ 0.75%; KNO₃ @ 1%; N:P:K @ 1%; N:P:K @ 1.5%; NaCl @ 0.5%; NaCl @ 0.75%; K₂SO₄ @ 0.5%; K₂SO₄ @ 0.75% along with water spray at 50% flowering and grain filling stages. The result in general, indicates that foliar applications of nutrients had a great influence on yield contributing characters and grain yield of wheat. The investigation clearly shows that significantly highest seed yield was recorded with foliar application of NaCl @ 0.5%. Simultaneously lowest seed yield observed from only water sprayed control treatment. The seed yield was increased up to 27.92% with the application of NaCl @ 0.5%. Similar trends were also noticed in yield contributing characters of the crop. Sole application of nutrients viz. NaCl @ 0.5%; NaCl @ 0.75%; KCl @ 0.75%; KNO₃ @ 0.75%; KNO₃ @ 1%; N:P:K @ 1%; N:P:K @ 1.5%; K₂SO₄ @ 0.5 %; K₂SO₄ @ 0.75% at 50% flowering on wheat was also recorded statistically higher grain yield and higher protein content over water sprayed control treatment. The findings found at this study can be used in management recommendations of wheat.

Keywords

Foliar application,
Micronutrients,
wheat

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Introduction

Wheat, a fine cereal, has played a stellar role in India's transformation from its ship-to-mouth existence of the 1960s to exporting grains as at present. With an output of 96.64 million tons harvested from 31.19 million

hectares in 2016-17, the country has emerged as the world's second largest producer of wheat. With the advent of terminal heat stress (sudden rise in temperature during grain filling period) adversely affecting wheat grown on 36 million ha area, comprising 40% of the temperate environment (Hays *et al.*,

2007), there is sheer urgency to find the mitigation strategies. The current trends in India also indicate that the 'cool period' for wheat crop is shrinking, while the threat of terminal heat stress is increasing (Joshi *et al.*, 2007). Delayed sowing of wheat due to late harvesting of rice is one of the main reasons for terminal heat stress in eastern part of India. Heat stress is an important constraint to wheat productivity affecting different growth stages specially anthesis and grain filling. Shriveled small grains are produced and different yield associated traits such as grain weight and grains numbers/spike is reduced. Biological yield, harvest index and spike length are severally decreased (Suryavanshi *et al.*, 2016). In West Bengal, the rise in temperature during critical stages of wheat is also leading to less production. Foliar fertilization is an important tool for the sustainable and productive management of crops. Furthermore, foliar fertilization is theoretically more environmentally friendly, immediate and target-oriented than soil fertilization.

It should be widely adopted in modern crop management where it should be used to ensure optimal crop performance when nutrient supply from the soil is inadequate or uncertain. Foliar fertilizers offer specific advantages over soil fertilizers when plant demand for nutrients exceeds the capacity for root nutrient uptake; when elemental mobility within the plant limits delivery to tissues; and when environmental conditions limit the effectiveness or prevent the application of nutrients to the soil. In many risk-averse, high-value production systems foliar fertilizers are marketed as 'insurance' to minimize the potential impacts of unpredictable nutrient deficiencies. Moreover, there is an increase in protein percentage of seed and yield components due to foliar application. Das and Sarkar (1978) demonstrated that the post flowering spraying

of NaCl solution in the late grain filling stage of wheat resulted in high grain yield through more translocation of photo synthates, especially the stroma ones, to the developing grains. Several studies showed Cl⁻ fertilizer, basically applied in the form of KCl, improved the productivity of wheat and other crops in the Great Plains. Freeman and Girma (2006) reported Cl fertilizer significantly increased wheat grain yields in 50% of the sites with 0, 15 and 30 kg Cl ha⁻¹ rates, and the increases were more notable on the sandy loam soil. However, numerous reports indicate a significant stimulation in the growth of many crops in response to Na, even under conditions of K-sufficiency. Foliar application is credited with the advantage of quick and efficient utilization of nutrients, eliminating losses through leaching, and fixation and helps in regulating the uptake of nutrients by plants (Manomani and Srimath, 2009).

There also is convincing evidence that Na can substitute for K in non-specific functions, such as being an osmoticum during cell enlargement and as a counter ion during long-distance transport. In the above roles, Na influences plant growth in a very significant way both as to growth rate and in efficient nutrient resource utilization. In the above roles, Na influences plant growth in a very significant way both as to growth rate and in efficient nutrient resource utilization. The functional role of Na in plant nutrition can be large, multi-faceted and of critical importance in both natural bio-systems and controlled plant production systems. Previously, many reports have estimated the wheat response to exogenous application of micronutrients (both soil and foliar applied), but a little is known regarding combined application of micronutrients. Therefore, the objective of this study is to check the effect of foliar application of nutrients on seed quality and yield of wheat.

Materials and Methods

The present experiment designed to study the performance of wheat (*Triticum aestivum* L.) as affected by spraying of different salt solution at 50% flowering was conducted at the Agricultural Experimental Station of Calcutta University, Baruipur, South 24 – Parganas, West Bengal (88° 26'E Longitude and 22° 22' North Latitude) during the *Rabi* season (December to April) of 2016-17. The soil of experimental plot was medium fertility, clay loam in texture, having 1.0% organic carbon, available phosphorus 34.18kg/ha and available potassium 278kg/ha with a pH of 6.35. HD 2967 is a double dwarf variety with an average plant height of 101 cm was used.

The treatments were assigned using randomized block design (RBD) with three replications on 10 different levels of foliar sprays including control check T1 (no spray), T2 KCl, @ 0.75%, T3 KNO₃@ 0.75%, T4 KNO₃@ 1.0%, T5 N: P: K@ 1.0%, T6 N: P: K@ 1.5%, T7 NaCl@ 0.5%, T8 NaCl@ 0.75%, T9 K₂SO₄@ 0.5%, T10 K₂SO₄@0.75%. The fertilizer was applied @ 100 Kg N, 50 Kg P₂O₅ and 50 Kg K₂O / ha in the form of urea, single super phosphate and muriate of potash respectively. The crop was irrigated with tube well water throughout the growth period. Necessary plant protection measures and agronomic practices were done whenever required. The crop was harvested at maturity and data on tillering, plant height, numbers of filled grains, 1000-grain weight, protein content and wheat yields were recorded. Data were analyzed statistically and differences determined using the LSD test (Gomez and Gomez, 1984).

Results and Discussion

Data presented in (Table 1) indicated that all the treatments have significantly recorded

higher grain yield and its components as compared to control. Total number of grains/panicle in NaCl @ 0.5% treated plots was found to be highest (40.68) in comparison to other foliar nutrient treatments which were 36.63 % more than the control. Similarly, all the foliar nutrient treatments recorded significantly higher test weight over water spray control treatment. Test weight was highest NaCl @0.5 % treated plot (43.80g) which is 8.59 % more than the water spray control. Seed yield was meaningfully affected due to foliar application of micronutrients in spite of unfavorable weather condition throughout the sowing and grain filling season, The highest seed yield (2840 kg/ha) was observed with foliar spray application of NaCl @ 0.5 % followed by NaCl @ 0.75%. But statistically these two treatments are at par.

All the foliar nutrition treatments enhanced seed yield significantly over control treatment. Spraying of only KCl @ 0.75 % concentration increased seed yield significantly over control by 11.56%. The increased seed yield might be due to enhanced partitioning efficiency and correcting transient nutrient deficiency during flowering and post flowering i.e. grain filling stage. Rahman *et al.*, (2014) found that the foliar treatment of KCl along with N results in maximum biological yield. The investigation revealed that both potassium sources i.e. KCl and KNO₃ are similar efficient in maximizing the wheat yield. Increased application of K⁺ has been shown to enhance photosynthetic rate, growth, yield and drought resistance in different crops under abiotic stress conditions (Egilla *et al.*, 2001) Seed quality parameters as presented in (Table 1) shows significant impact by foliar application treatments, Best result with respect to germination of wheat seed was observed with foliar application of NaCl @ 0.5% (Table 1) which was closely followed by NaCl @ 0.75 %.

Table.1 Effect of treatments on germination, root length, shoot length, seedling length and vigour index

Treatments	Germination (%)	Mean Root Length (Cm)	Mean Shoot Length (Cm)	Mean Seedling Length (Cm)	Vigour Index
T1-Control	83.33	7.81	9.02	16.83	1401.94
T ₂ KCl @ 0.75%	86.66	8.71	9.09	17.81	1541.48
T ₃ -KNO ₃ @ 0.75%	86.66	8.13	9.46	17.59	1523.29
T ₄ -KNO ₃ @ 1.0%	86.66	9.07	9.79	18.86	1633.28
T ₅ -N:P:K @ 1%	80	8.60	10.01	18.61	1488.80
T ₆ -N:P:K @ 1.5%	83.33	8.95	9.72	18.68	1555.21
T ₇ -NaCl @ 0.5%	90	10.05	10.55	20.61	1854.00
T ₈ -NaCl @ 0.75%	90	9.44	9.87	19.310	1737.90
T ₉ -K ₂ SO ₄ @ 0.5%	90	8.08	9.28	17.36	1562.40
T ₁₀ -K ₂ SO ₄ @ 0.75%	96.66	8.99	9.47	18.46	1783.24
C.D. (0.05)	NS	NS	NS	NS	-

Table.2 Effect of treatments on number of filled grains (seeds), test weight and seed yield of wheat

Treatments	Filled Grains/Panicle	Test Weight (G)	Seed Yield (Kg/Ha)	% Increase Yield Over Control
T ₁ -Control	29.78	40.33	2220	-----
T ₂ KCl @ 0.75%	37.75	42.77	2660	19.81
T ₃ -Kno ₃ @ 0.75%	38.01	41.57	2480	11.71
T ₄ -Kno ₃ @ 1.0%	36.95	42.27	2420	9.00
T ₅ -N:P:K @ 1%	37.98	42.51	2380	7.20
T ₆ -N:P:K @ 1.5%	38.02	42.87	2370	6.75
T ₇ -NaCl @ 0.5%	40.68	43.80	2840	27.92
T ₈ -NaCl @ 0.75%	38.42	43.62	2790	25.67
T ₉ -K ₂ so ₄ @ 0.5%	37.93	42.33	2370	6.75
T ₁₀ -K ₂ so ₄ @ 0.75%	36.46	42.62	2320	4.50
C.D. (0.05)	0.59	0.93	0.035	-----

The data on MRL and MSL clearly showed that all the foliar nutrients application significantly increased that two important characters of seed quality and maximum total seedling length was recorded under foliar application of NaCl @ 0.5 %; NaCl @ 0.75 %; N: P: K @ 1 %; N: P: K @ 1.5% etc. With regards to vigor index, similar trend was observed and again foliar spray with NaCl @ 0.5 % found to be the best treatment.

Considering the aforementioned facts, it could be concluding that the foliar application by NaCl, KNO₃, KCl, N: P: K and their combination increased grain yield (Table 2).

It could be concluded from the study that foliar applications of nutrients had a great influence on yield contributing characters and grain yield of wheat. Hence, the post flowering foliar application of NaCl @ 0.5%

at 50% flowering and grain filling stages is found to be beneficial to increase the grain yield and seed quality of wheat.

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