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Effect of coated fertilizers on yield, nutrient use efficiency, and economic returns in Bt cotton

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Abstract
A field trial was conducted during the *Kharif* season of 2020-21 at the Research Farm, Department of Soil Science and Agricultural Chemistry, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani. The study aimed to investigate the impact of coated fertilizers on soil properties, as well as the yield and quality of Bt cotton. A set of nine treatments viz.T_1-Absolute control, T_2-Recommended dose of fertilizer (Through straight fertilizer) T_3-RDF through coated fertilizer grade (N:P_2O5:K_2O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2), T_4-RDF through non coated fertilizer grade (N: P_2O5:K_2O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2), T_5-25% reduction to RDF with coated fertilizer grade, T_6-25% reduction to RDF with non-coated fertilizer, T_7-50% reduction to RDF with coated fertilizer, T_8-50% reduction to RDF with non-coated fertilizer, T_9-RDF through straight/complete fertilizers + individual secondary and Micronutrients as per treatment second for basal dose only were organized in a randomized block design with three replications. The experimental result revealed that the yield parameter like seed cotton yield, dry matter yield, mean boll weight, test weight showed significantly highest in treatment (T_3) receiving RDF through coated fertilizer grade (N:P_2O_5:K_2O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2) respectively. Additionally, nutrient use efficiency, gross monetary returns (GMR), net monetary returns (NMR), and benefit-cost ratio (B:C) were highest in T_3. Coated fertilizers exhibited superior performance in terms of nutrient use efficiency and economic viability compared to other treatments and making it a sustainable and cost-effective approach for Bt cotton cultivation. Thus, the application of RDF through coated fertilizers is recommended for maximizing yield, nutrient efficiency, and economic returns in Bt cotton cultivation.

Keywords: Bt cotton, coated fertilizers, yield, nutrient use efficiency

Introduction

Cotton (*Gossypium hirsutum* L.) is one of the most important commercial cash crop and important fiber crop of global significance cultivated in more than seventy countries. popularly known as "White gold or friendly fiber". The cotton plant belongs to the genus *Gossypium* of the family *Malvaceae*. It is grown for fiber and seed. Cotton is a multipurpose crop that supplies five basic products such as lint, oil, meal, seed and hulls and is popularly known as "King of Fiber". India rank first in area and second in production of cotton after China. In India, cotton is grown in ten states, out of which nine states grow both bt as well as non-bt cotton and Odisha is the state which grows only non-bt cotton. Maharashtra, Gujarat and Telangana occupy 70% of the total cotton area in India and 60% of overall cotton production in the country. These three states cultivate cotton in different agroclimatic conditions. Maharashtra state is the largest area and production under cotton cultivation in the country, but per hectare productivity is far below as compare to cotton growing states. In Maharashtra, cotton is the major crop cultivated in large extent besides soybean, maize, rice, wheat, pulses and other oilseeds. In general, Bt cotton hybrids are suitable for irrigated condition and it has been proved from production and productivity levels of Gujarat, Punjab and Haryana.

In modern agriculture, chemical fertilizers play a crucial role in meeting the nutrient demands of crops and achieving high yields. However, conventional fertilizers often release nutrients rapidly, leading to losses through various pathways and a mismatch between nutrient availability and plant uptake. To address these challenges, slow-release and controlled-release fertilizers have been developed. These innovative fertilizers offer a means of improving nutrient use efficiency, reducing environmental pollution, and promoting sustainable agricultural practices by synchronizing nutrient release with plant requirements. The efficient use of fertilizers is critical for sustainable crop production.

Controlled-release it was discovered that phosphate fertilizers produced by covering phosphatic fertilizers with wax, conditioner, asphalt, sulphur, wax, and sulphur were useless. This may be because the rate of release of phosphorus from these fertilizer products was much slower than the rate required by crops. However, this suggestion has recently been proven through testing the hypothesis without using specialised P fertilizer products. Therefore, it appears that using controlled-release phosphatic fertilizers could improve crop yields and phosphorous efficiency (Pauly *et al*., 2001) [10]. When urea is applied in the field, it is hydrolyzed by urease enzyme to ammonia (NH_4) and then further converted to nitrates (NO^-_3) which are susceptible to volatilization, denitrification and leaching losses, respectively. The arrest of nitrogen loss can help to increase nitrogen utilization per unit area. It will help in lowering the cost of cultivation and increase in benefit to farmers and minimizing nitrate pollution. Recently several techniques have been evolved to coat the fertilizer material, which will help to reduce the losses and ensure their sustained release. Later on many slow release urea fertilizers like sulphur coated urea (SCU), neem oil coated urea (NOCU), isobutylidienediurea (IBDU) and lac coated urea (LCU) etc. have been developed. If urea fertilizers are modified with indigenously available material like neemcake, then they are economical to the farmers for farm use (Bharathi and Sekar, 2016) [1].

Materials and Methods

A field trial was conducted during the *Kharif* season of 2020-21 at the Experimental Research Farm, Department of Soil Science and Agricultural Chemistry, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani. The experiments on cotton were conducted to study the "Studies on Efficacy of Coated Fertilizer on Soil Properties, Yield and Quality of Bt Cotton". The soil of experimental site was black soil dominant in Montmorillonite mineral which is inherently rich in lime, iron and magnesium (Gajbe *et al*., 1976) [2]. The soil was alkaline in reaction (pH 8.28), low in salt content (0.20 dS m^{-1}) with high calcium carbonate content (10 g kg^{-1}). The organic carbon status of the soil was medium (6.6 g ha^{-1}). The soil available nitrogen was low (172.48 kg ha^{-1}), available phosphorus was medium (9.11 kg ha^{-1}), available potassium was very high (705.6 kg ha^{-1}) and available sulphur was medium (20.55 mg kg^{-1}). The experiment was carried out in Randomized Block Design (RBD) with ten treatments and three replications. A set of nine treatments viz.T_1-Absolute control, T_2-Recommended dose of fertilizer (Through straight fertilizer)T_3-RDF through coated fertilizer grade ($N:P_2O_5:K_2O:S:Mg:Zn:B$ 11:23:10:4:1.9:0.4:0.2), T_4-RDF through non coated fertilizer grade (N: P_2O_5:K2O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2), T_5-25% reduction to RDF with coated fertilizer grade, T_6-25% reduction to RDF with non-coated fertilizer, T_7-50% reduction to RDF with coated fertilizer, T_8-50% reduction to RDF with non-coated fertilizer, T_9-RDF through straight/complete fertilizers + individual secondary and Micronutrients as per treatment second for basal dose only. Certified seed of cotton (Ajeet 155 BG II) were sown in *Kharif by* dibbling two seeds per hill. The total numbers of balls per plant from five observational plants were counted at 60, 90 and 120 days after sowing. At time of second picking seed cotton from five well opened representative bolls from each plant were picked and average bolls weight in (g) were recorded on each plant, seed cotton yield from each plot were recorded, Cost of cultivation was calculated by addition of all the cost incurred towards purchasing of inputs. And also Gross monetary returns, Net monetary returns, Benefit cost ratio were calculated. The nutrient use efficiency was calculated by using different nutrient use efficiency measures *viz*., partial factor productivity, agronomic efficiency and apparent nutrient recovery. The data were analyzed by statistical method as suggested by Panse and Sukhatme (1985) [9].

Results and Discussion

Yield parameter of Bt cotton enhanced on application of coated fertilizer

The number of bolls per plant is a critical yield-determining parameter in cotton production, as it provides an estimation of the probable yield. The results from the study, as presented in Table 1, indicate significant variations in the number of bolls per plant across different fertilizer treatments at various growth stages. The data show that the number of bolls per plant increased progressively from 30 DAS to 90 DAS across all treatments. The highest number of bolls per plant was consistently recorded in Treatment T_3, which received the recommended dose of fertilizer (RDF) through a coated fertilizer grade ($N:P_2O_5:K_2O:S:Mg:Zn:B$-11:23:10:4:1.9:0.4:0.2). Specifically, T_3 recorded 24.30, 30.03, and 33.84 bolls per plant at 30, 60, and 90 DAS, respectively. This could be attributed to the controlled release of nutrients, ensuring a sustained supply of essential elements throughout the plant's growth stages. Treatments T_4 and T_5, which received RDF through non-coated fertilizer and a 25% reduction to RDF with coated fertilizer, respectively, also exhibited a high number of bolls per plant. The results suggest that even with a 25% reduction in RDF, the use of coated fertilizers (T_5) maintained boll production close to that of the full RDF application, indicating efficient nutrient utilization. The absolute control treatment (T_1) recorded the lowest number of bolls per plant across all growth stages, with values of 18.10, 23.37, and 26.73 at 30, 60, and 90 DAS, respectively. This suggests that nutrient deficiency significantly limits boll formation, leading to lower productivity. The findings align with previous research by Hosamani *et al*. (2013) [5], who reported that an increased seed cotton yield was associated with a higher RDF application, likely due to enhanced nutrient availability and uptake, leading to better boll retention and formation. The results emphasize the effectiveness of coated fertilizers in improving nutrient efficiency and sustaining cotton yield.

The data on effect of coated fertilizer on dry matter yield of cotton, mean boll weight of cotton, seed cotton yield (q ha^{-1}) are presented in Table 1. Significantly maximum mean boll weight of cotton *i.e*., 3.62 g was recorded in treatment (T_3), receiving RDF (120:60:60 Kg NPK ha^{-1}) through coated fertilizer grade ($N:P_2O_5:K_2O:S:Mg:Zn:B$ 11:23:10:4:1.9:0.4:0.2) followed by (T_5), receiving 25% reduction to RDF (120:60:60 Kg NPK ha^{-1}) with coated fertilizer grade 3.22 g, (T_7), receiving 50% reduction to RDF(120:60:60 Kg NPK ha^{-1}) with coated fertilizer 3.16 g. However, minimum number of bolls per plant was recorded in (T_1) *i.e*., Absolute control 2.70 g. Significantly maximum dry matter yield of cotton *i.e*., 2887.73 kg/ha was recorded in treatment (T_3), followed by (T_5), (T_7). However, minimum dry matter yield of cotton was recorded in (T_1) *i.e*., Absolute control 2407.40.The result revealed that the seed cotton yield varied in the range of 532.00 to 1667.00 (Kg ha^{-1}). Significantly seed cotton yield (q ha^{-1}) of cotton *i.e*., 1667.00 kg/ha was recorded in treatment (T_3), receiving RDF (120:60:60 Kg NPK ha^1) through coated fertilizer grade (N: P_2O_5:K_2O: S: Mg: Zn: B 11:23:10:4:1.9:0.4:0.2) followed by (T_5), T_7. Depicted in fig.2. However, minimum seed cotton yield (q ha^{-1}) of cotton was recorded in (T_1) *i.e*., Absolute control 532.00 kg/ha. Hosamani *et al*. (2013) [5] reported that increased in seed cotton yield with 125 percent RDF might be due to significantly higher number of good opened boll per plant, total number of bolls harvested per plant, mean boll weight, amount of dry matter accumulation in reproductive parts of and leaf area upto harvest.

Table 1: Impact of coated fertilizer on yield parameter of Bt cotton.

Treatments	Number of bolls $plant^{-1}$			Mean boll weight $plant^{-1}$ (g)	Dry matter yield (kg ha^{-1})	Seed cotton yield (Kg ha^{-1})
	30 DAS	60 DAS	90 DAS			
T_1-Absolute control	18.10	23.37	26.73	2.70	2407.40	532.00
T_2-Recommended dose of fertilizer (Through straight fertilizer)	20.25	25.97	29.15	2.89	2592.59	864.00
T_3-RDF through coated fertilizer grade (N:P_2O_5:K_2O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	24.30	30.03	33.84	3.62	2887.73	1667.00
T_4-RDF through non-coated fertilizer grade (N:P_2O_5:K_2O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	22.43	28.57	31.97	3.17	2648.58	1363.00
T_5-25% reduction to RDF with coated fertilizer grade	23.21	28.77	31.78	3.22	2791.67	1443.00
T_6-25% reduction to RDF with non-coated fertilizer	21.84	26.77	31.37	3.06	2603.33	1171.00
T_7-50% reduction to RDF with coated fertilizer	21.72	27.52	31.23	3.16	2641.67	1015.00
T_8-50% reduction to RDF with non-coated fertilizer	21.10	24.80	30.57	2.83	2740.16	857.00
T_9-RDF through straight/complete fertilizers + individual secondary and micronutrients as per treatment second for basal dose only	21.44	26.57	29.78	3.12	2610.67	1093.00
SE m±	0.37	0.76	0.83	0.07	25.07	2.69
CD at 5%	1.12	2.28	2.49	0.22	75.16	8.09

Optimizing Bt Cotton Economics through Coated Fertilizer Application

The economic evaluation of coated fertilizers in cotton cultivation is crucial for understanding their cost-effectiveness and profitability. Effect of coated fertilizer on economics of cotton presented in Table 2. Data showed that the highest gross return (GMR), net monetary returns (NMR), and benefit-cost ratio (B:C) noticed with treatment (T_3) receiving RDF through coated fertilizer grade (N:P_2O_5:K_2O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2) followed by T_5>T_7. The benefit cost ratio varied from Rs 1.19 to 2.20. the highest benefit cost ratio observed in treatment (T_3), receiving RDF (120:60:60 Kg NPK ha^{-1}) through coated fertilizer grade (N:P_2O_5:K_2O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2) depicted in fig.1 followed by T_5>T_7. Our results are corresponds with Niranjan *et al*. (2017) [7], who reported that neem-coated urea significantly improved economic returns in soybean compared to conventional fertilizers. Similar result were found by Sharma and Singh 2011. [12], Sanders *et al*., 2012. [11], Shivay *et al*., 2016. [13], Hatano *et al*., 2019 [4].

Table 2: Effect of coated fertilizer on economics of cotton crop

Treatment	Cost of cultivation (Rs ha^{-1})	GMR (Rs ha^{-1})	NMR (Rs ha^{-1})	B:C Ratio
T_1-Absolute control	46185	55328	9142.50	1.19
T_2-Recommended dose of fertilizer (Through straight fertilizer)	61222	89856	28634	1.46
T_3-RDF through coated fertilizer grade (N:P_2O_5:K_2O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	78602	173368	94766	2.20
T_4-RDF through non-coated fertilizer grade (N:P_2O_5:K_2O:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	68705	141752	73046	2.06
T_5-25% reduction to RDF with coated fertilizer grade	73052	150072	77020	2.05
T_6-25% reduction to RDF with non-coated fertilizer	62937	121784	58846	1.93
T_7-50% reduction to RDF with coated fertilizer	60207	105560	45353	1.75
T_8-50% reduction to RDF with non-coated fertilizer	55002	89128	34125	1.62
T_9-RDF through straight/complete fertilizers + individual secondary and micronutrients as per treatment second for basal dose only	64025	113672	49646	1.77

Effect of Coated Fertilizers on Nutrient Use Efficiency in Bt Cotton

Nutrient use efficiency is a crucial parameter in assessing the effectiveness of fertilizer application in crop production. The study evaluated partial factor productivity (PFP), agronomic efficiency (AE), and apparent nutrient recovery (ANR) to determine the impact of coated fertilizers on nutrient utilization efficiency in Bt cotton (Table 3). Partial factor productivity, which measures nutrient use efficiency based on economic and biological yield per unit of nutrient applied, was highest in T_7 (50% reduction to RDF with coated fertilizer), followed by T_8, T_3, and T_5. This indicates that even with reduced RDF, the use of coated fertilizers significantly enhanced nutrient use efficiency. Our results are related to findings of Ghafoor *et al*. (2021) [3] the results show that, the positive effect of coated fertilizers was found on growth, development, physiological, yield and PFP in wheat crop. Gromor bentonite S pastille at 20 kg S ha^{-1} showed higher sulfur recovery than gypsum or SSP, likely due to its higher concentration, reduced leaching, and gradual release (Jena and Kabi, 2012) [6].

Agronomic efficiency, calculated as the yield difference between fertilized and control plots per unit of nutrient applied, followed a similar trend. The highest AE was observed in T_7, followed by T_8, T_3, and T_5. These findings similar with the study of Tesfay and Girmay (2019) [14], who reported that combined agronomic efficiency was lower than individual nutrient agronomic efficiency, highlighting the importance of balanced fertilization. Apparent nutrient recovery, another measure of nutrient use efficiency, was highest in T_7, followed by T_8, T_3, and T_5. These results support the findings of Noor *et al*. (2017), who observed a positive effect of coated fertilizers on nutrient uptake and recovery efficiency. Study indicates that coated fertilizers enhance nutrient use efficiency, particularly under reduced RDF conditions. The findings suggest that adopting coated fertilizers can optimize nutrient utilization, improve cotton yield, and contribute to sustainable agricultural practices. Result were similar to Hatano *et al*., 2019 [14].

Table 3: Influence of coated fertilizer on nutrient use efficiency (partial factor productivity, agronomic efficiency and apparent nutrient recovery) in cotton crop.

Treatments	Nutrient Use Efficiency		
	Partial factor productivity ($Kg\ Kg^{-1}$)	**Agronomic efficiency ($Kg\ Kg^{-1}$)**	**Apparent nutrient recovery (%)**
T_1-Absolute control	-	-	-
T_2-Recommended dose of fertilizer (Through straight fertilizer)	13.15	2.14	7.21
T_3-RDF through coated fertilizer grade ($N:P_2O_5:K_2O$:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	18.97	4.63	32.52
T_4-RDF through non-coated fertilizer grade ($N:P_2O_5:K_2O$:S:Mg:Zn:B 11:23:10:4:1.9:0.4:0.2)	16.71	4.45	18.28
T_5-25% reduction to RDF with coated fertilizer grade	23.52	7.17	29.43
T_6-25% reduction to RDF with non-coated fertilizer	20.96	4.62	22.23
T_7-50% reduction to RDF with coated fertilizer	30.47	5.94	30.07
T_8-50% reduction to RDF with non-coated fertilizer	29.97	5.45	21.67
T_9-RDF through straight/complete fertilizers + individual secondary and micronutrients as per treatment second for basal dose only	15.43	3.17	13.12
SE m±	0.29	0.17	0.28
CD at 5%	0.90	0.53	0.87

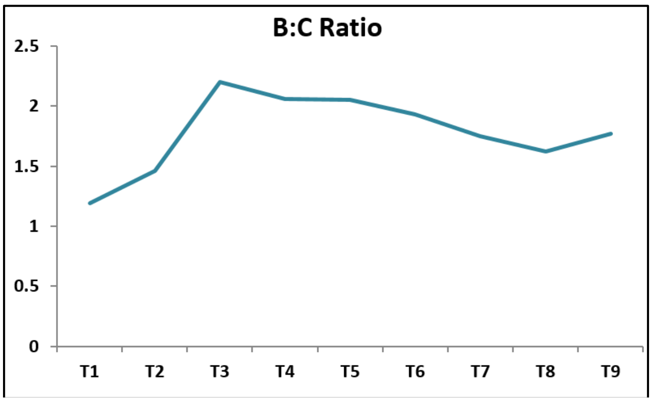

Fig 1: Impact of Coated fertilizer on B:C Ratio.

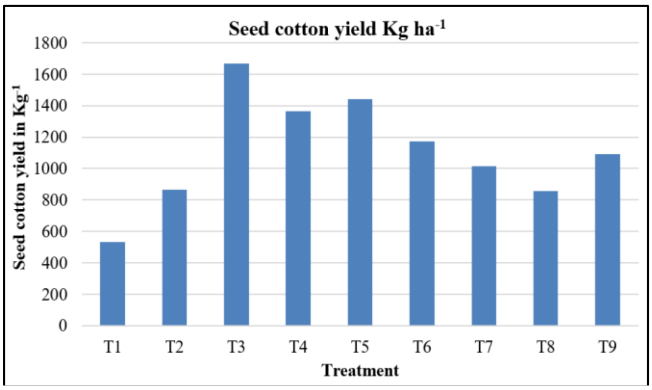

Fig 2: Impact of coated fertilizer on yield of Bt cotton.

Conclusion

From above study we can conclude that the application of coated fertilizers significantly enhanced Bt cotton yield, nutrient use efficiency, and economic returns. Among the different treatments, the recommended dose of fertilizer (RDF) applied through coated fertilizer (T_3) exhibited the highest seed cotton yield, dry matter yield, and mean boll weight. This treatment also achieved the highest nutrient use efficiency and economic benefits, with the highest gross monetary returns, net monetary returns, and benefit-cost ratio. Even with a 25% reduction in RDF (T_5), coated fertilizers maintained higher productivity and economic viability than non-coated alternatives. These findings highlight that coated fertilizers provide a sustainable and cost-effective approach to optimizing Bt cotton production by reducing nutrient losses, enhancing crop performance, and improving profitability. Thus, the application of coated fertilizers is recommended for maximizing yield and economic benefits in Bt cotton cultivation.

References

1. Bharathi CS, Sekar K. Effect of various forms of urea and GA_3 on soil available nitrogen, phosphorus and potassium in chrysanthemum (*Chrysanthemum morifolium* Ramat). Adv Life Sci. 2016;5(3):921-924.
2. Gajbe MV, Lande MV, Varade SB. Soils of Marathwada. J Maharashtra Agric Univ. 1976;1:55-59.
3. Ghafoor I, Habib-ur-Rahman M, Ali M, Afzal M, Ahmed W, Gaiser T, Ghaffar A. Slow-release nitrogen fertilizers enhance growth, yield, NUE in wheat crop and reduce nitrogen losses under an arid environment. Environ Sci Pollut Res. 2021;28(32):43528-43543.
4. Hatano S, Fujita Y, Nagumo Y, Ohtake N, Sueyoshi K, Takahashi Y, Ohyama T. Effect of the nitrification inhibitor 3, 4-dimethylpyrazole phosphate on the deep

placement of nitrogen fertilizers for soybean cultivation. Int J Agron. 2019;2019:1-11.
5. Hosamani V, Halepyati A, Vinodakumar SN. Yield and yield components, quality parameters, uptake of nutrients and economics of irrigated Bt cotton (*Gossypium hirsutum* L.) as influenced by macronutrients and liquid fertilizers. Ecol Environ Conserv. 2013;19(4):1189-1193.
6. Jena D, Kabi S. Effect of gromor sulphur bentonite sulphur pastilles on yield and nutrient uptake by hybrid rice-potato-green gram cropping system in an Inceptisol. Int Res J Agric Sci Soil Sci. 2012;2(5):179-187.
7. Niranjan HK, Rathi D, Sharma HO, Chouhan RS, Thakur SS. Crop response to the application of NCU in major kharif crops: an impact assessment in Central India. Econ Aff. 2017;62(4):691-695.
8. Noor S, Yaseen M, Naveed M, Ahmad R. Use of controlled release phosphatic fertilizer to improve growth, yield and phosphorus use efficiency of wheat crop. Pak J Agric Biol Sci. 2017;54(4):541-547.
9. Panse VG, Sukhatme PV. Statistical methods for agricultural workers. New Delhi: ICAR; 1985.
10. Pauly DG, Malhi SS, Nyborg M. Controlled-release P fertilizer concept evaluation using growth and P uptake of barley from three soils in greenhouse. Can J Soil Sci. 2001;82(2):201-210.
11. Sanders JD, Murphy LS, Noble A, Melgar RJ, Perkins J. Improving phosphorus use efficiency with polymer technology. Procedia Eng. 2012;46:178-184.
12. Sharma VK, Singh RP. Organic matrix based slow-release fertilizer enhances plant growth, nitrate assimilation and seed yield of Indian mustard (*Brassica juncea* L.). J Environ Biol. 2011;32(5):619-624.
13. Shivay YS, Pooniya V, Prasad R, Pal M, Bansal R. Sulphur-coated urea as a source of sulphur and an enhanced efficiency of nitrogen fertilizer for spring wheat. Cereal Res Commun. 2016;44(3):513-523.
14. Tesfay T, Girmay S. Economic performance and nutrient use efficiency of onion (*Allium cepa* L.) under N, K and S nutrient combinations in Northern Ethiopia. Open Agric J. 2019;13(1):1-8.