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Response of modified fertilizers on yield, yield attributing parameters and nutrient uptake of Rice (*Oryza sativa*) in rice –wheat cropping system.

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Abstract:

Two year field experiment was carried out during Kharif season of 2018-2019 at the research field of Lovely professional University, Phagwara, Punjab to study the response of modified fertilizers on yield, yield attributing characters and nutrient uptake of rice in rice-wheat cropping system. The experiment was laid out in randomized complete block design with three replications and nine treatments namely- T0 Control (RDF),T1 Neem coated urea(NCU) +PK recommended,T2 Anhydrous ammonia(AA)+ PK recommended,T3 NCU+ PK+S+ Zn-EDTA, T4 AA +PK+ S+ Zn-EDTA, T5 NCU +PK+$ZnSO_4$, T6 AA +PK+ $ZnSO_4$, T7 RDF + $ZnSO_4$,T8 RDF+ S+ Zn-EDTA. The results obtained showed that T3 performed significantly better than other treatments for almost all the agronomic yield attributing characters –plant height-113.3cm, tillers per plant-13,number of panicles per plant-11,panicle length-23.53, filled grains per panicle -62,test weight-21.03g, grain -5913 kgha^{-1} and straw yield(6321 kg ha^{-1}) ,chlorophyll content-53.33,Fresh weight of plant-174.73g, nutrient uptake 142kgha^{-1}N,49 kgha^{-1} P,112kg ha^{-1} K,52 Kg ha-^{1} S. Thechemical propertiesof soil i.e. pH-6.68,EC-0.40dsm^{-1}, available nitrogen-255 kgha^{-1},available phosphorous 34.53 kgha^{-1},available potassium 397 kg ha^{-1} was found maximum in T3 and lowest under T0(control treatment).Thus it can be concluded that neem coated urea along with chelate and S are equally effective for rice-wheat cropping system as compared to ordinary urea.

Keywords:*Available potassium, anhydrous ammonia, neem coated urea, rice-wheat cropping system, sulphur*

1. Introduction: *Oryza sativa* is always used as staple food for approximately half of the world's population.International Rice Research Institute (2013). According to the research rice is used as a primary source of food and it always provided more than 50% of the diet calories as well as some part of protein for 520 million people living in Asia. Muthayya, S*et al.,* (2014). In Punjab rice is most important and required cereal crop cultivated in 2.814 million hectares and producing 0.2 million tonnes/annum. (MOAC (2013). We have

enough food supply, but population is increasing ay by day and in the coming years we will have shortage of food supply due to decreasing cultivation of land and uneven use of fertilizers by the farmers. Every farmer wants more and more yield from their piece of land, and they are applying more fertilizers from recommended doses. In this way the crop production was increased up to one level only and now the soil becomes toxic in nature due to more application of fertilizers. The climate also played vital role in crop production. Sometimes the rainfall appeared on time and sometimes there is uneven rainfall. Which is a headache of the farmers. In the dry land areas, all the farmers are depended upon the rainfall only. There is heavy loss of water due to evaporation and transpiration. According to the research point of view rice crop needs more water availability as comparison to other crops. But due to unfavourable climatic conditions farmers will suffer and ultimately crop production decreased. (Taddesse, E. (2009). By this problem there was water scarcity problem, crop lodging problem, more weed infestation problem, very less soil moisture problem. All of them was responsible for less soil fertility. The soil fertility was affected by more application of fertilizers. (Taddesse, E. (2009). For reduction in that problem's researcher working very well, they are making hybrid seeds for more production and giving knowledge to farmers by holding conferences with farmers and guiding to farmers that apply recommended doses only. I have used slow releasing fertilizers as neem coated urea. Which is releasing nitrogen fertilizer very slowly in the field and it is easily available to crops at every stage of the growth. Fertilizers are playing important role for the crops. (Taddesse, E. (2009). In now days farmers are mostly depended upon hybrid seeds, so inorganic fertilizers are required to complete the requirement of seeds and breeders are always working on it due to increasing population day by day.Tisdale *et al.,* (1984). Different types of nitrogen fertilizers affecting rice grain size, weight and yield like neem coated urea is working as a slow releasing fertilizer, it means if we are applying normal urea (non-coated urea) than plant will use more amount of urea at once and when plant need next dose of fertilizer at that time fertilizer will not present in field. So, neem coated urea is much important as a slow released fertilizer at time to time. (Gately, T.F*et al.,* (1987). Farmers always applying inorganic fertilizer which is to much costly for taking more production but in this way soil pH is affected (toxic in nature) and yield decreased, due to imbalanced of fertilizer. (Saleque, M. A*et al.,* (2004).

2. Materials and Methodology

2.1 Study site

This experiment was conducted on agricultural research field of Lovely Professional University, Phagwara, Punjab during Kharif (rice) seasons of 2018 and 2019. The experimental farm geographically situated at latitude 31.25^0N and longitude75^o Eat an altitude of 232 m above sea level. The soil samples were collected from 0-15 cm depth and examined for its different Physical and chemical properties like, pH, EC, N, P, K, organic carbon, and zinc. The experiment was laid out in randomized complete block design with nine treatments and three replications with two irrigation channels between them. The plot size was $5\times4m^2$.The testing material used for experiment was Pusa basmati 1121.The treatments consists of T0 Control (RDF),T1 Neem coated urea(NCU) +PK recommended, T2 Anhydrous ammonia(AA) + PK recommended, T3 NCU+ PK+S+ Zn-EDTA, T4 AA +PK+ S+ Zn-EDTA, T5 NCU +PK+$ZnSO_4$, T6 AA +PK+ $ZnSO_4$, T7 RDF + $ZnSO_4$, T8 RDF+ S+ Zn-EDTA.

The recommended dose of fertilizers for basmati rice was 42:30:30kg/ha (N: P: K), Zinc-10kg, Sulphur-45kg/ha. Nitrogen was supplied through ordinary urea, neem coated urea, and anhydrous ammonia, phosphorous and potassium through SSP and MOP, sulphur through elemental S, zinc through $Znso_4$ and Zn-EDTA. The soil of experimental site is represented as Typic Haplustept and classified as coarse sandy loamy in texture.

2.2 Plant parameter study

a. Plant height – Random 10 plants was selected and tagged properly by aluminium tagged from different rows and same plants was used for taking plant height. On proper days interval. Which are 20, 40, 60, and 80 DAT.

b. Tillers (No. of tillers/hill) – Healthy plant tillers was selected, and no. of tillers was counted properly from tagged plants. The flag leaf stem was also included.

2.3 Yield contributed characters of rice crop

a. No. of tillers and effective tillers –There are two types of tillers one is total tillers and second is effective tillers, both was recorded properly. Effective tillers mean presence of grains and total tillers with and without grains tillers. without grain tillers are recorded as a non- effective tiller.

b. Panicle length –The panicle length was properly recorded from tagged plants to avoid any kind of error/hill. The mean value is taken as panicle in cm unit.

c. Sterility percentage of grains –For proper grain filling lemma and palea is most important but due to water stress condition the grain will remain unfilled or there is empty grain at critical growing stage, namely at the time of meiosis (10 – 15) days before flowering stage.

No. of grains and dry grains were calculated by given formulae.

$$\text{Sterility \%} = \frac{\text{No. of unfilled grains}}{\text{Total no. of grains}} \times 100$$

d. No. of grains/panicle –From tagged panicles, the total no. of grains/panicle was which was selected randomly.

e. Test weight –Test weight of 1000 grains was recorded or measured properly to estimate the yield quantity. The weight of thousand grains was recorded in gm.

2.4 Yield measurements

a. Grain yield –The grain yield was recorded by each plot after harvest and threshing. After cleaning the grains, data was converted into yield/hec. as kg/hec. (Paudel, M.N. (1995).

b. Straw yield –After threshing the straw was dried by sunlight in open field for 3-4 days. So, that the excess moisture content should not present. Then straw yield was measured by each plot and converted into ton/hec.

c. Harvest straw –Harvest index is considered as the grain yield ratio and the total above ground biomass. Which is indicate to economic parts of the rice (i.e grains). Highest harvest index always represent to the good capability of assimilates having economic importance from the source like (longest leaf of the plant) to the last grain which are considered as sink.

$$\text{Harvest index} = \frac{\text{Economic yield}}{\text{Biological yield}}$$

3.Result and discussion:

Plant height (cm): Plant height was recorded at four successive intervals. The data recorded at 20, 40, 60 and 80 days after transplanting (DAT) as influenced by different modified fertilizers presented in Fg.1. Plant height was significant under effect of modified fertilizers. The combination of different fertilizers influenced the plant height. The maximum plant height (66.20, 74.27, 103.33, 113.73 cm) recorded at 20, 40, 60, 80 DAT with the combination of NCU+PK+S+Zn-EDTA. This combination showed superiority in plant height over all other treatments which was followed by T5 with (61.77, 73.33, 101.4, 112.3 cm) at all intervals. Neem coated urea performed well over ordinary urea, similarly Zn-EDTA performed better than $ZnSO_4$.The lowest plant height (54.3, 63.3 cm) at 20,40 DAT recorded with T4 but at 60 and 80 DAT it was recorded with T0(78.4 and 86.23 cm). Significant effect of rice was observed by many authors in past (MT Rahman 2008and NK Fageria 2001).

Total tillers and effective tillers: The application of Neem coated urea, anhydrous ammonia**,** Zn-EDTA, $ZnSO_4$ on tillers was significantly influenced. The total number of tillers and effective tillers was presented in fig. 2. The highest number of total tillers (13.33) was found in T3 (NCU+ PK +S+ Zn-EDTA) which was at par with T5 which represent 12.97 total tillers per hill and lowest (8.30) found in control. The highest number of effective tillers (11.5) per plant was found in T3 followed by T5 which represents 11.03 effective tillers per hill. The lowest effective tillers (6.77) per plant recorded with T0. The application of NCU+ PK +S+ Zn-EDTA improved soil physical, chemical and biological properties contributed to better crop growth rate and shoot development of rice.

Chlorophyll content (SPAD): Chlorophyll content recorded at two intervals 40 and 80 DAT. presented in fig. 3. The highest chlorophyll content (47.3, 55.3) at 40 and 80 DAT recorded with the T3 which was followed by T5, T8, T7, T1 at both intervals. The lowest chlorophyll content (33.4) recorded at 40 DAT with T5 and at 80 DAT with T2 (37.57). The results are in conformity with the findings of Kumar and Singh (2018).

Panicle length (cm): Results in fig. 4 showed that panicle length was significantly influenced by different fertilizers combination. There was significant response noted on higher panicle length (23.53 cm) followed by T5 (22.60 cm) which was significantly superior over other treatments. The low length of panicle (19.2 cm) observed in T4. Panicle length directly affects grain yield by more transport of photosynthesis material (B. Azayed, 2011). The similar result was found by (MT Rahman 2008, V. Nagesh 2012).

Filled grains panicle: Data in fig. 5 shows the effect of modified fertilizers on filled grains per panicle. The filled grains per panicle ranged from 44-62.20. The highest grains per panicle (62.20) measured in T3 which was identical to T5 representing 60.6 filled grains per panicle. The lowest value was recorded in T0 (44.3) Similar results were observed by Islam *et al.,* 2011 and Rahman *et al.,* 2008. Application of Zn and S along NPK was effective in improving rice growth and subsequently main yield components such as filled grains per panicle.

Test weight: Data presented in Fig. 6 showed that test weight was significantly different among treatments. The highest test weight (21g) recorded in T3 which was at par with T5 having (20.77 g) test weight and followed by T1 (20.13g) and lowest in T0 (18.97g). Similar results were found by Pushpanathan*et al.,* 2003 who observed that yield component like productive tillers, panicle length, filled grains per panicle and 1000 grain

weight improved by application of coated fertilizers. This result also corroborates with the findings of Kumar *et al.,* (2018).

Grain yield: Grain yield is the additive result of yield contributing characters of rice shown in Fig.7. The grain yield was significantly superior in T3 (5913 kg ha^{-1}) which was followed by T5 (5839.8 $kgha^{-1}$) lowest 4161 $kgha^{-1}$ grain yield recorded in T2. The grain yield obtained from different treatments may be ranked in order of T3> T5>T1>T8>T7>T6>T0>T4>T2. The grain yield was increased due to addition of Zn-EDTA + S along with NCU+PK which provides better physical, chemical, and biological soil condition to plant and increases the number of effective tillers and number of grains per panicle. Broadcasting of ordinary urea tends to increase various losses of n through lower yield compared with NCU which slowly release nutrients and reduce losses and higher uptake of nutrients. Similar results were found byShivay*et al.,* 2000 and Suganya*et al.,* 2007 also recorded more grain yield with NCU.

Straw yield: The straw yield was increased with NCU over anhydrous ammonia and ordinary urea. The maximum straw yield (6354 kg ha^{-1}) was recorded in T3 which was at par with T5 with 6284 kg ha^{-1} straw yield. It was followed by T1 and T8 with (5717, 5427 kg ha^{-1}) and lowest in T2 (4161 kg ha^{-1}). Nitrogen influenced vegetative growth in terms of plant height and number of tillers m^{-2} which increased straw yield. It might be due to the increased nitrogen use efficiency and continuous supply of nitrogen boosting vegetative growth. Sarangi SK*et al.,* (2016). Data presented in Fig7.

Harvest index (%): The data regarding harvest index has been presented in Fig.8. Highest harvest index 48.97% recorded with NCU+PK+ Zn-EDTA+S, which was at par with T1, T5 and T8 with 48.77, 48.67 and 48.08%. The lowest HI recorded in in T0 (45.07%). Harvest index reflects the portioning of photosynthesis between grain and vegetative plant and increase in HI reflects the importance of carbohydrate allocation for grain production. Similar results were found by Bhuvaneswary*et al.,* 2007 and Muthukumararaja*et al.,* 2012.

4. Discussion: Plant height, number of tillers, chlorophyll content of plant was increased due to application of NCU+PK+ Zn-EDTA+S. It might be due to combination of macro and micronutrients. Zinc is involved in carbohydrate metabolism through its important role in photosynthesis and sugar transformation. Zinc plays a key role in upholding the membrane Integrity in plants. It helps in maintaining the membrane structure and integrity and ion transport as observed in cell membrane. Sulphur also improved plant height, number of tillers and chlorophyll content might be due to utilization of S and optimum use in growth. According to Singh *et al.,* (2006), sulphur application increases the plant height significantly and the tallest plants were recorded with 45 kg S ha^{-1} at all the stages. This might be due to rapid growth causes by adequate Sulphur supply to the crop, which resulted increased in various metabolic processes and performed carbohydrate metabolism of the crop plants might be attributed to more number of tillers and increase of plant height which ultimately increased the size and number of green leaves due to favourable utilization of sulphur and thus contributed to higher chlorophyll content. Chandel*et al.,* (2003) also reported the similar result that plant height, tillers increased due to increased uptake of nutrients.

Yield contributing characters like number of effective tillers number of panicle plant^{-1}, panicle length; number of grain panicle^{-1} and test weight was significantly increased with NCU+PK+ Zn-EDTA+S. This has consequently increased the grain as well as the straw yield of rice crop. This might be because Zn had also helped in uptake of nitrogen along with other nutrient elements. Increase in yield with NPK S Zn might be due to due to a greater number of panicles, grain panicle^{-1} and test weight. Higher yield under high nitrogen levels was due to adequate sulphur supply which contributes to increased dry matter production. Productivity of crop is collectively determined by the vegetative growth and yield attributes. Better vegetative growth coupled with higher yield attributes resulted in higher grain and straw yield of rice. Similar result was reported by Mrinal *et al.,* (2008). Increase in yield might be due to Zn is present in several dehydrogenate proteins and peptidase enzymes being a constituent responsible for growth hormones, has induced more starch formation promoted seed filling maturation^{-1} and ultimately production. Well-developed source and sink capacity of plant has ultimately resulted in higher yield with higher levels of sulphur. Increase in yield with Zn-EDTA might be due to more uptake of Zn as compared to $ZnSO_4$. The superiority of zinc application for grain yield might be due to improvement in soil physico chemical properties which supports roots of plant (Singh and Shivay, 2013).

5. Figures

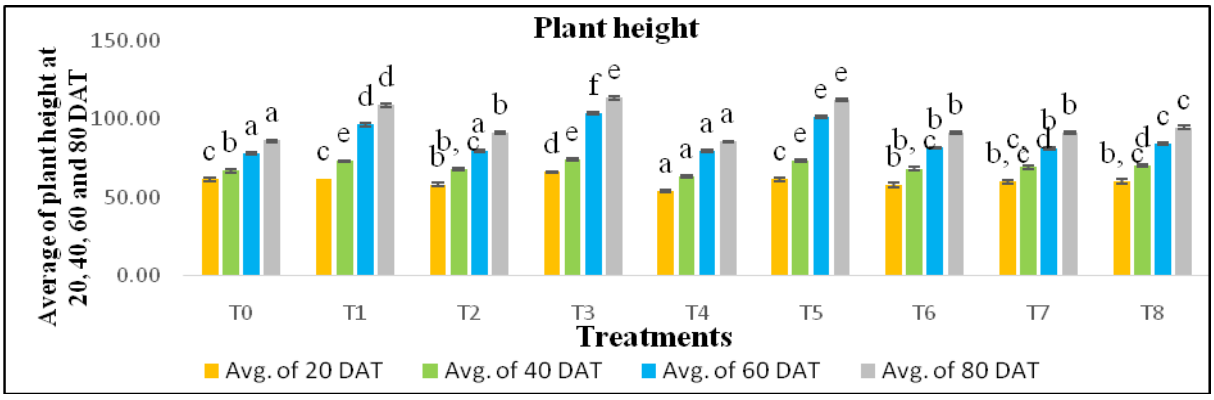

Fig.1 Representing the plant height in cm at 20,40,60 and 80DAT.Data shown as mean of S.E. Means with same letters for each figure are not significantly different according to LSD at p<0.05.

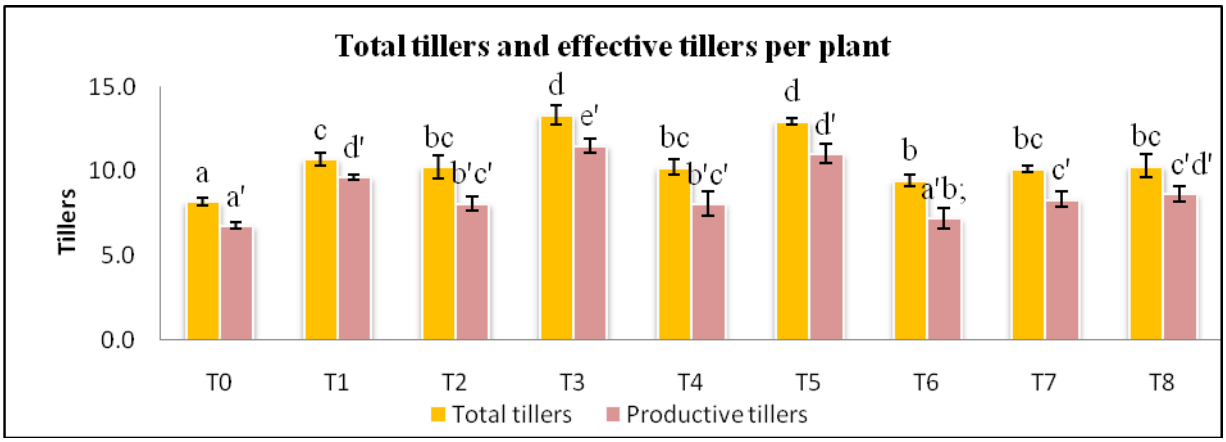

Fig 2. Representing the total no. of tillers with productive tillers. Data shown as mean of S.E. Means with same letters for each figure are not significantly different according to LSD at p<0.05.

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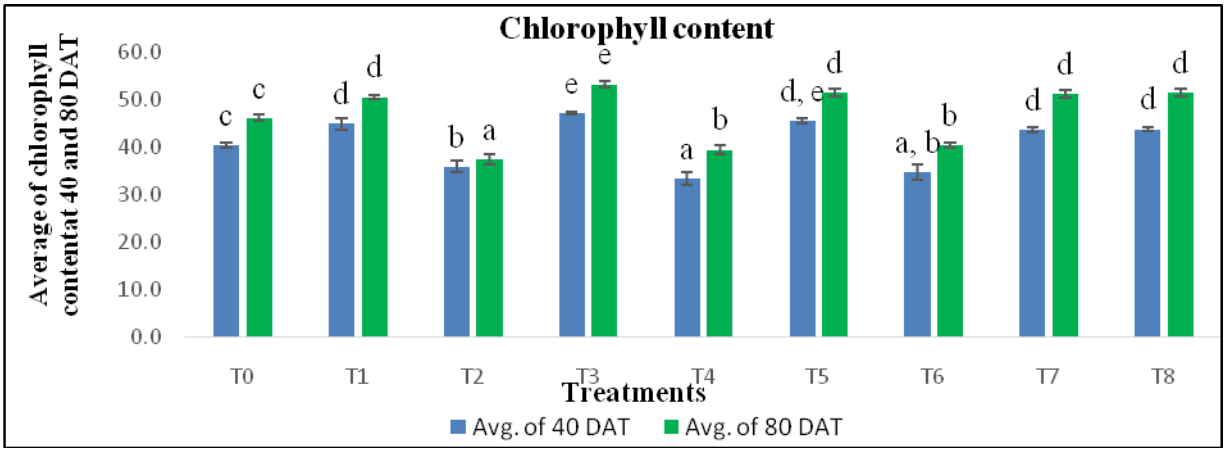

Fig.3 Representing the chlorophyll content in SPAD. Data shown as mean of S.E. Means with same letters for each figure are not significantly different according to LSD at $p<0.05$.

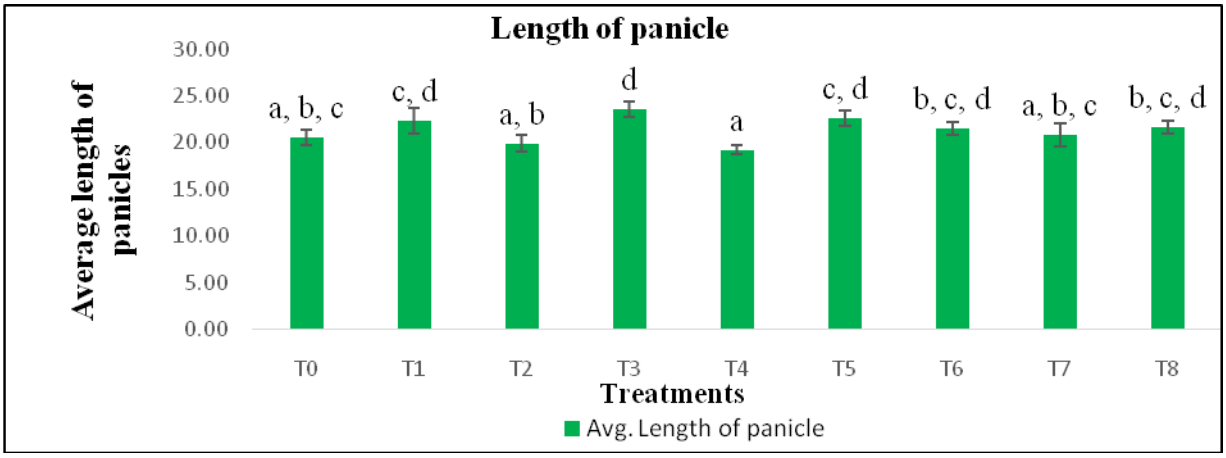

Fig.4 Representing the Panicle length in cm. Data shown as mean of S.E. Means with same letters for each figure are not significantly different according to LSD at $p<0.05$

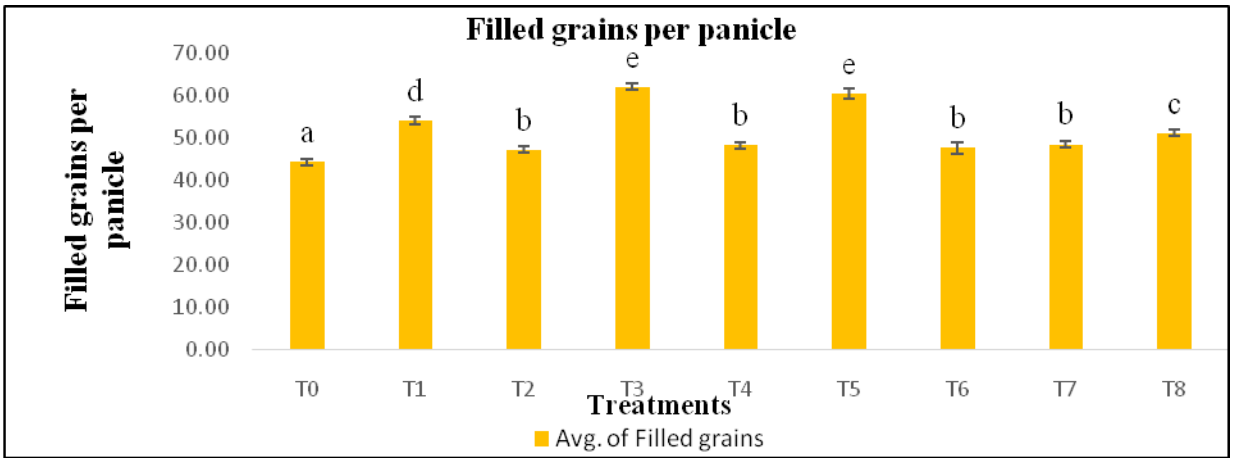

Fig.5 Representing the filled grains per panicle. Data shown as mean of S.E. Means with same letters for each figure are not significantly different according to LSD at p<0.05.

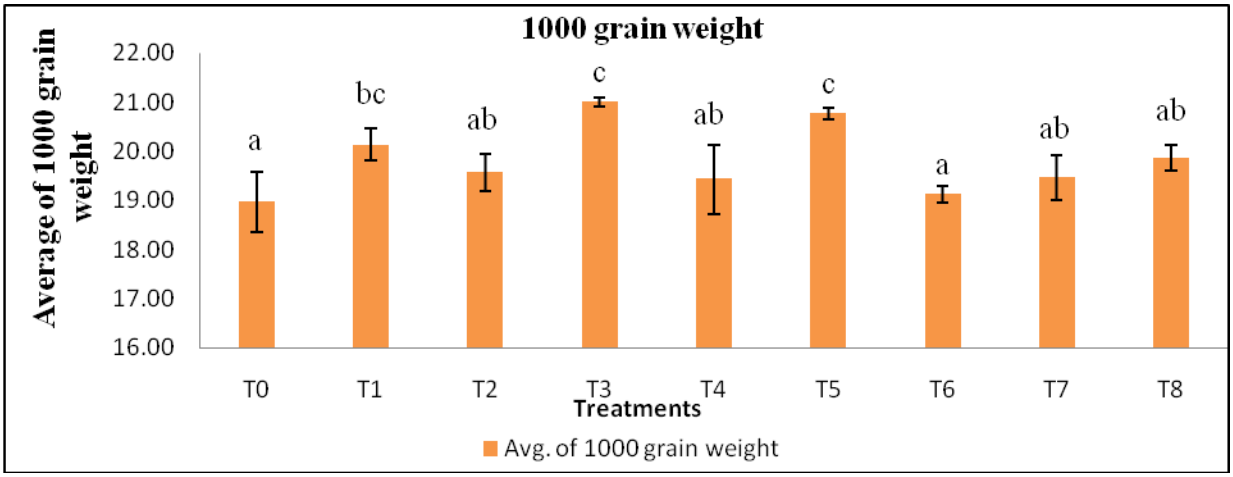

Fig 6 Representing test weight(g) of rice grains. Data shown as mean of S.E. Means with same letters for each figure are not significantly different according to LSD at p<0.05.

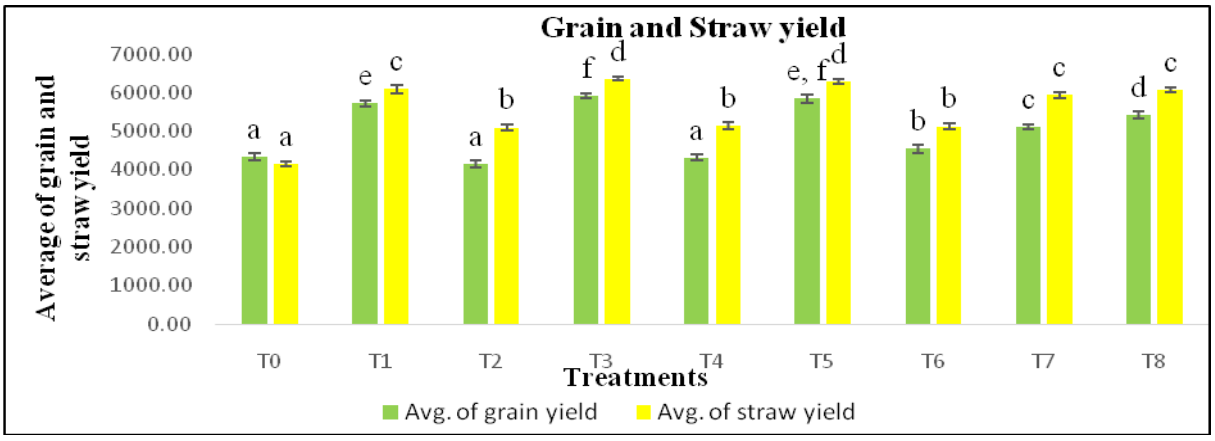

Fig.7. Representing the grain yield and straw kg/ha. Data shown as mean of S.E. Means with same letters for each figure are not significantly different according to LSD at p<0.05.

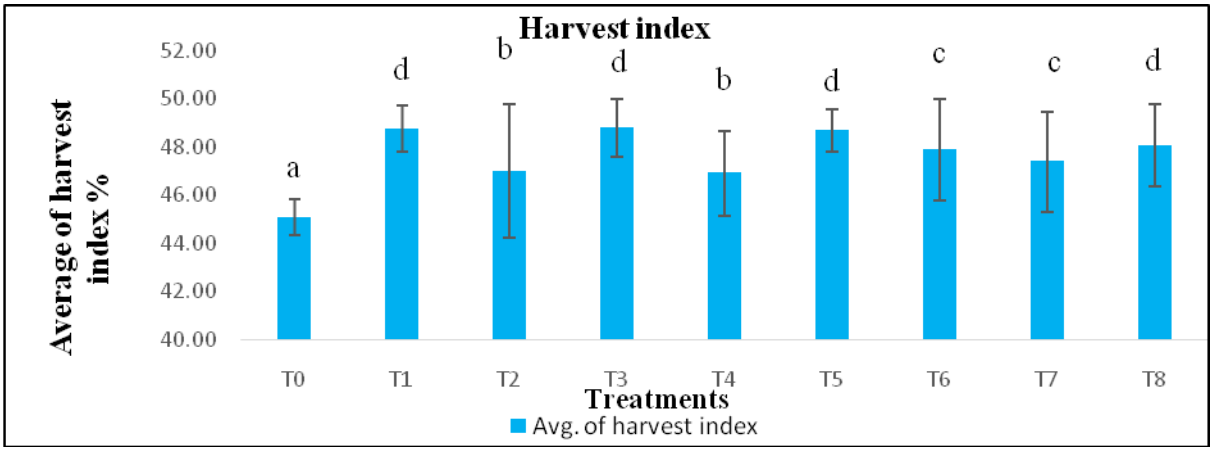

Fig. Representing the harvest index (%). Data shown as mean of S.E. Means with same letters for each figure are not significantly different according to LSD at p<0.05.

6. Conclusion

In now days farmers are mostly depended upon hybrid seeds, so inorganic fertilizers are required to complete the requirement of seeds and breeders are always working on it due to increasing population day by day. But soil health is degrading continuously by using excess amount of fertilizers which are toxic in nature. SO, that recommended dose of fertilizers is much need and to complete the requirement of crops slow released fertilizers are needed.

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7. References:

1. International Rice Research Institute (2013). The massive benefits of global rice research. Retrieved in June 9, 2016.

2. Muthayya, S., Sugimoto, J. D., Montgomery, S., &Maberly, G. F. (2014). An overview of global rice production, supply, trade, and consumption. Annals of the New York Academy of Sciences, 1324(1), 7-14.

3. MOAC (2013). Statistical information on Nepalese Agriculture, Kathmandu: Ministry of Agriculture and Cooperatives/Agribusiness Promotion and Statistics Division.

4. Taddesse, E. (2009). Rice (*Oryza sativa* L.) cultivars: Morphology and Classification part II. Experimental Station Bulletin 66. Addis Ababa University, College of Agriculture, Dire Dawa (Ethiopia). 73p.

5. Tisdale, S.L. & Nelson, W.L. (1984). Soil Fertility and Fertilizers, Third Ed. Pp: 68-73. McMillan Publ. Co., Inc., New York.

6. Gately, T.F. and Kelly, D. (1987). Sources of nitrogen for spring barley. Soils and Grassland Production Research Report, pp 27-8. Dublin. A ForasTaluntais. http://irri.org/news/media-releases/the-massive-benefits-of-global-rice-research.

7. Saleque, M. A., Naher, U. A., Islam, A., Pathan, A. B. M. B. U., Hossain, A. T. M. S., & Meisner, C. A. (2004). Inorganic and organic phosphorus fertilizer effects on the phosphorus fractionation in wetland rice soils. Soil Science Society of America Journal, 68(5), 1635-1644.

8. Paudel, M.N. (1995). Nutrient management for Sulphan buri- 90 rice variety in acid sulfate soil with green leaf manure. M.Sc. Thesis, Asian Institute of Technology, Bankok, Thailand. Pp 23-51.

9. M T Rahman, M Jahiruddin, M R Humauan, M J Alam, A A Khan, *J Soil Nature*, **2008**. 2(3): 10-15N K Fageria, *Agricola*, **2001**, 58 (3): 623-626.

10. Fageria, N. K., Dos Santos, A. B., and Cobucci, T. (2011). Zinc nutrition of lowland rice. *Communications in Soil Science and Plant Analysis*, 42, 1719-1727.

11. Kumar A, Singh A P. 2018. Direct and residual effect of zinc and boron on growth parameters of rice and wheat grown in sequence in red and alluvial soils of eastern Uttar Pradesh. *InterJ Chem Stud*, **6**: 587-592.

12. B A Zayed, A K M Salem, H M El Sharkawy, *World Journal of Agricultural Sciences*, **2011**, 7 (2): 179-184.

13. V Nagesh, V Ravindrababu, G Usharani, T Dayakar Reddy, *Annals of Biological Research*, **2012**, 3 (1):179-184.

14. Islam,2011. Effect of prilled urea, urea super granule and poultry manure on field water properties and the growth and yield of transplant Aus BR21, Life Sci. J. 11(8): 101-108.

15. Pushpanathan KR, Vijayakumar M, Siddeswaran K. Effect of forms of fertilizer nitrogen and timing of application on growth and yield of rice (*Oryza sativa l.*) Agriculture Review. 2005; 2:153-156.

16. Shivay YS, Prasad R, Singh S. Effect of nitrogen levels and neem-oil emulsions coated urea on growth, yield attributes and yield of wetland rice. In: Extended Summary of International Conference on Managing Natural Resources New Delhi ICAR. 2000; 3:1340-1342.

17. Suganya S, Appavu K, Vadivel A. Nitrogen release pattern of neem coated urea products in flood water. An Agriculture Journal of Soil Science. 2007; 2:128-133.

18. Sarangi SK, Maji B, Singh S, Srivastava AK, Singh US, Sharma DK. Nitrogen management through neem coated urea and application method further improve rice productivity in coastal flood-prone rainfed lowland, 4th International Agronomy Congress New Delhi. 2016; 2:22-26.

19. Bhuvaneswary, R., Srivamchandra, S.M.V., Ravichandran, M., 2007. Effect of organic and grated level of sulphur on rice yield and sulphur use efficiency. *Journal of Interacdemicia*11(1), 51–54. 2008.

20. Muthukumararaja, T. M., and Sriramachandrasekharan, M. V. (2012). Effect of zinc on yield, zinc nutrition and zinc use efficiency of lowland rice. *Journal of Agriculture science and Technology*, 8, 551-561.

21. Singh S, Shivay YS.2006 Coating of prilled urea with ecofriendly neem *(Azadirachtaindica a juss.)* formulations for efficient nitrogen use in hybrid rice. Acta AgronomicaHungarica. 2003; 51:53-59.

22. Chandel, R.S., Sudhakar, P.C., Singh, K., 2003. Response of sulphur in rice. *Agricultural Review* 24(3), 167–174.

23. Mrinal, B., Sharma, S.H., 2008. Effect of rates adds sources of sulphur on growth and yield of rice *(Oryza sativa)* and soil sulphur. *Indian Journal of Agriculture Science*, 78(3), 251–253.

24. Singh A, Shivay Y S. 2013. Residual effect of summer green manure crops and Zn fertilization on quality and Zn concentration of durum wheat (*Triticum durum* Desf.) under a Basmati rice-durum wheat cropping system. *Biol Agric Hort*, **29**: 271-287.