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Modern Leaf Colour Chart Successfully Prepared and Used in Crop Production of Sindh, Pakistan

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Abstract:

Leaf colour chart (LCC) is known as one of the important innovation in the agricultural sector of the world. It was the first time prepared by scientists of Japan. They used this for estimation of chlorophyll formation rate in the rice (Oryza sativa L.) crop and then more various investigations on leaf colour chart were done which showed that it is important for better nitrogen management. N deficiency can easily be rectified with no devastation of plant parts. Nowadays, the leaf colour chart is being successfully used worldwide for the proper rate of nitrogen application and thus boosting the greatest productivity. Study was begun in 2013 using of diverse literature available on leaf colour chart from various resources. The mirror, paper, painting colours, aluminium and plastic tape, glue, plastic shopper, pencil, geometrical instruments and camel brushes of different sizes were used as material. All processes step by step

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completed. As result, a new modern leaf colour chart (LCC) was successfully prepared during 2014 and It was further continually improved and finalized in Feb-2016. The manufacturing of this LCC was comprised on absolutely new thoughts and consequently no relative work was found on the globe. New modern mirror made leaf colour chart is named as "Nitrom" that is a combination of two words such as "nit"" implies nitrogen and "rom" means room. In this sense it is a controlled condition, limited space, specialized point or specific spot of the tool in which nitrogen deficiency can be measured and corrected. Significant results were observed on growth and yield of rice crop in field job, when N insufficiency was corrected by using of this LCC (Nitrom). It is the need of time that number nitroms should be prepared and provided to farmers with free of cost to withstand in front of the issue of lacks of technology in agriculture of Pakistan. And this paper must be translated in different languages and literature given to farmers. After read of this experiment, they can be able to produce their leaf colour chart (Nitrom) for self-use and can maximize yield.

Key words: LCC, Nitrom, Rice, Nitrogen. Crops, Pakistan

INTRODUCTION

The leaf colour chart (LCC) was the first time introduced in the agricultural sector of the world by scientists of Japan. They made it for estimation of chlorophyll formation and its availability in plants, after the continuous studies, many researchers proved that it is pivotal for the measurement of nitrogen deficiency and its correction. It is easy to use (Nachimuthu et al., 2007). The leaf colour chart has six (06) colours varies from yellowish to dark greenish just like lush green colour of plants, each colour is changed from the one another

(Sathiya et al., 2009) and has size about three multiply by eight (3x8) which is constructed of good quality plastic material (Singh et al., 2006). However, In different regions of Asia the leaf colour chart used is seven centimeter (07 cm) wider and about thirteenth to twenty centimetres (13 to 20 cm) longer, contains 4 to 6 colours, starts from yellow and ends with lush green at last (Hushmandfar & Kimaro, 2011). A researcher belongs to Zheijiang Agriculture University, China produced leaf colour chart comprised 8 colours (Yang et al., 2003). Similar work was already conducted at University of California researcher added all eight colours with green colour by some changes. While, a IRRI scientist prepared LCC in which have only 4 colours (Boyd, 2001; Fairhurst et al., 2007). It is developed from the best quality material of plastics (Furuya, 1987). The leaf colour chart is very much useful that provides accurate results in determination of N deficiency in plant same as like a meter used for chlorophyll measurement which displays exact values(IRRI, 2003). LCC well diagnosis N insufficiency (Mohanty et al., 2013). The Philippines made a leaf colour chart is inexpensive and simple as well. It was developed from the International rice research institute (IRRI) Minela, Philippines (Balasubramanian et al., 1999). LCC famously is used on rice crop throughout the world (Follett et al., 1992). But generally all crops become yellow due to improper supply of nitrogen, so, LCC can also be used on various crops belonging to monocot class which having narrow leaf structure. LCC is gaining importance (Ravi et al., 2007). It is can be best for wheat (Varinderpal et al., 2012) and also for maize (Varinderpal et al., 2011; Anthony et al., 2015). Leaf colour chart is helpful for adequate supply of fertilizers with their good interval and need (Witt et al., 2005). In the world, commonly farmers do not care the need of the plant for nutrients. They have schedule fixed with a split application of fertilizer (Pillai et al., 1993). Sharif, (1994) said that the supply

of N to crop as their need is crucial which provides a higher crop yield with the best quality, N is a major plant nutrient (Dastan et al., 2012). Therefore, fertilization of N, must be optimum with judicious application through LCC analysis. Using the leaf colour chart has many advantages, among them, it is non-cost full and very easy to use, it optimized well nitrogen use in oryza sativa L. crop (Singh et al., 2006; Alam et al., 2005; Shukla et al., 2004). Use of LCC is simple and quick as well (Hussain, 2000), so, every farmer can use it without getting any technical skills and training (Singh et al., 2010). Moreover, it is a rapid technique of measuring nitrogen deficiency (Singh, 2008). Many scientists used leaf colour chart in field experiments and concluded good results in terms of growth and yield of rice, increase in yield of about 19.9% to 46.2% was recorded with LCC's colours (3,4 and 5 respectively). Application of N on the 4 and 5 LCC reading based maximized yield (Gupta et al., 2011; Krishnakumar and Stephan, 2013; Mathukia et al., 2014). Sen et al. (2011) concluded in an experiment that LCC less than 5 showed higher yield in rice. This was due to nitrogen, which was applied according to LCC entire crop period. It gave significant results (Sapute et al., 2015); Yadvinder et al., 2007). Furthermore, generally the proper rate of N supply improves crop yield (Peng et al., 2010; Ali et al., 2011), because of application of N with specific management has maximum chances to increase efficiency of nutrient used by the plant (Nath et al., 2013; Hirel et al., 2011). It prevents deficit and excess application of fertilizers (Budhar and Tamilselvan, 2003). It has been seen that estimate 60 percentages of nitrogenous (N) fertilizer losses due to improper management (Yadav et al., 2004). Supply of N suited and fitted with the requirement of the plant, for that LCC is very much useful (Alam et al., 2005) which saves N (Bhat et al., 2015) and thus farmers money (Das et al., 2015). The maximum crop yield is associated with excellent nutrient management practices

(Chen et al., 2015) and it can be obtained through use of LCC. In the view of importance of Leaf colour chart (LCC) for better nitrogen management, the present study was started to prepare leaf colour chart on self-basis and introduce in agriculture of Sindh, Pakistan for the support of farmers community.

MATERIALS AND METHODS

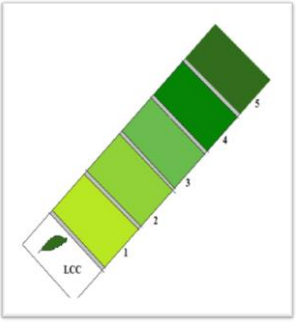
A study was started in 2013 using of different literature available on leaf colour chart from internet sources and successfully prepared mirror made LCC during 2014 and It was further continue improved and finalized in Feb-2016 and used on the rice crop. It was made on totally new ideas. The mirror, paper, painting colours, aluminium and plastic tape, glue, plastic shopper, pencil, geometrical instruments and camel brushes of various sizes were used as material. The mirror was thin and white and papers were selected white. We used white paper because colours best suit on it. The paper was like, which is used on digital Photoshop and usually photographs are printed on that. Step by step all phases were carefully and technically completed by colouring the paper which is determined most troublesome section to proper pasting of coloured paper below the mirror till numbering and binding it with plastic and aluminium tape (Fig. 2 & 3). White paper was painted with suitable colours, first of all dull green colour was painted over white paper and after then yellow colour was applied on that dull green colour which gave a look like yellowish colour on the paper then second colour (2nd) was given some variable from first colour of LCC. Accordingly third colour (3rd) was painted and thus fourth (4th) colour where yellow colour was not used. Fifth (5th) colour of LCC which was last sectional colour, painted with dark-green colour by applying of green and dark colour. This phase is very scientific and most technical compare to all other stages of LCC from

which it undergoes. After completion of colouring section, the painted paper was pasted below the mirror with the help of glue. Paper was banded with plastic tape and then aluminium tape. Sides was numbered which were referred as LCC's reading values. All constructive stages of LCC were carefully completed.

RESULTS AND DISCUSSION

Mirror made Leaf colour chart (LCC) was successfully produced and introduced in the agricultural system of Sindh, Pakistan. It was planned to produce 15 LCCs with the help of local non-governmental organizations (NGOs), but due to lack of resources this objective cannot be achieved. However, single leaf colour chart was prepared and used in different areas as individual approach and obtained good results. Which was the main objective of this study and that was achieved. Farmers were wondered and impressed to see this technology. They showed their interest in this new LCC (Nitrom) and they demanded this to provide them, for getting better yield from their crops. Leaf colour chart (LCC) is stronger against sunlight and no sectional colour can reduce its brightness and thus does not become dim in colour due to adverse effect of heat or light, because, its mirror functioning as protection from all environmental factors including sunlight and precipitation. So, it can be useful for many years (Fig.01). This LCC can be best utilized by randomly selection of five to ten (05-10) non diseased plants and any damage to the plant should be avoided during the use of LCC (Nitrom). All plants must be tagged if you are going to continue N management and fertilizer application with help of LCC reading. Compare leaves with various colours of LCC, where the leaf colour is matching with LCC colour, note that reading, obtain all readings and then finally calculate to get mean. If the mean value representing lower reading of LCC

which starts from 1-2 that means crop is greatly N deficient and has highly need of N nutrient and thus immediately nitrogenous fertilizer with a good dose must be applied. While if the result of reading is 2-4 is mean that crop has need of nitrogen in small quantity. So, small amount of N can be useful in such conditions. However, LCC reading from 4.5-5 does not require more supply of N because at this reading of LCC, crop normally has dark-green or lush green colour which means there is no N deficiency. Understandings of LCC's colours have great important.



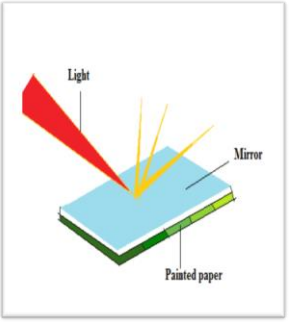


Figure 01. Leaf colour chart (LCC) **Figure 02. Mirror showing protection**

Monocotyledons are those plants which have narrow, straight and large leaves. They belong to gramineae/poaceae family like rice (*Oryza sativa* L.), wheat (*Triticum aestivum* L.), sugarcane (*Saccharum officinarum* L.), millet (*Pennisetum glaucum* (L.), maize (*Zea mays* L.), sorghum (*Sorghum bicolor* (L.), Onion (*Allium cepa* L.) etc. Leaf colour chart is mainly used on rice, but other all these crops are important from LCC usage point of view because they have same leaf structure and composition (Fig.03). Their N deficiency can also be estimated and managed well. For this, much study should be conducted in the world on the topic of how much extensive LCC can be used in agriculture.

Figure 03. Monocotyledons crops having narrow leaf, where, LCC can also be used

This mirror made leaf colour chart was new named as "Nitrom" which is a combination of two words such as "nit" means nitrogen and room means room. In sense it is a controlled condition, limited space, specialized point or specific place of the tool in which nitrogen deficiency normally can be observed and estimated for well N management. The name was purposed by Shah Jahan leghari and Umed Ali Leghari. They are both M. Sc scholars at Sindh Agriculture University Tandojam (Pakistan).

Figure 04. The leaf colour chart (LCC) made from paper and mirror, firstly used on rice crop at village/town Pirstop, Taluka, Sakrand, District Shaheed Benazirabad, Sindh, Pakistan (2014)

After distribution of leaf colours chart in different areas of Sindh, farmers will be able to obtain full advantage of this new technology. They can use it on rice and different related narrow leaf crops in their fields and can correct N deficiency by applying of the optimum dose of nitrogen. It can be the best guide for farmers, they easily can use and boost up their crop yield through estimation of N by supplying balanced amounts of

nitrogen. Sindh as well throughout Pakistan, most farmers are poor. So, they cannot go to laboratories and afford the higher cost of analytical reports for plant and soil. Moreover, there is no suitable facility available in the country at field step for N analysis. In these situations, leaf color chart is greatly important for farmers.

Figure 05. Greater nitrogen deficiency can seen in this image

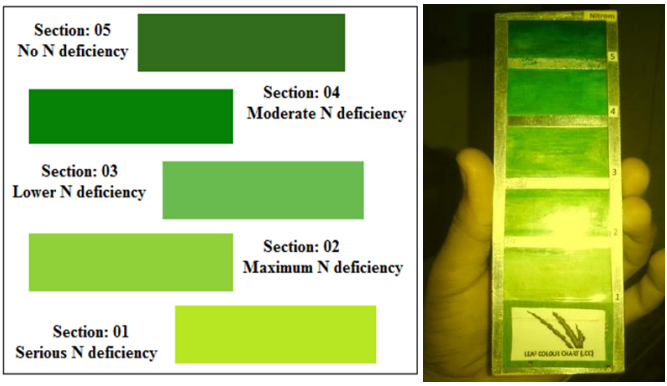


Figure 06. Different colours of LCC are well indicator of nitrogen deficiency in plant

Using a leaf colour chart, crop growth and yield can be improved up-to 100% by the application of nitrogen at the proper time and rate because dose of N according to LCCs guide will be more judicious and adequate and without any analysis of plant and soil, the supply of nitrogen fertilizer is non planned and improper, therefore, LCC must be used as good facility.

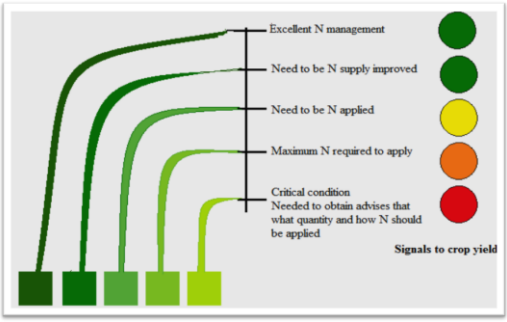


Figure 08. LCC colours are guiding for nitrogen application

The agriculture of Sindh is highly strong by nature due to good source of irrigation from the Indus river and has most favorable environmental characteristics for maximum crop yield, but the lacks of technology is a burning issue that restricts crop production to obtain higher yield as compared to other countries. In this scenario, government and agricultural students of Sindh are required to play scientific role for sustainable development of agriculture. This leaf colour chart (Nitrom) will significantly improve the agriculture of mother land. Our study supported from the thousand researchers and given references in this paper.

CONCLUSIONS

It is the need of time that many leaf colour charts (Nitroms) should be prepared and supplied to farmers with free of cost to withstand in front of the issue of lacks of technology in agriculture of Sindh, Pakistan, which is known as an agricultural state in the country. For further, this paper must be translated in different languages and literature provided to farmers and local agricultural manufacturing companies. After studying of this experiment, they can be able to produce their leaf colour chart (Nitrom) for self-use and can maximize yield. Promotion and development of agriculture is the need of time,

therefore, new research areas of study should be explored. It seems that improper application of nitrogen is a common cause of lower yield. Poor farmers are unable to analyze N inadequacy of plant and soil from laboratories. They are cost full as well as time consuming in Sindh. Therefore, providing of LCCs to farmers means to fortify the agriculture sector and making farmers self-sufficient for well nutrient management. They will apply the exact and right fertilizer dose and can obtain a maximum crop yield, which is ultimately beneficial for the country that relies on agriculture. LCC is offered in the world on price of only 01$ USD. Along these lines, it can likewise be manufactured in the country with minimal cost and minimal effort. Suggestions are given that, further study should be conducted in the world on this new modern leaf colour chart (Nitrom) and it is more improved by involving of computer science and technology with the integration of agricultural science, where it is digitized. A light indicator should be inserted in LCC (Nitrom) and whenever the colour of a plant's leaf matches with LCC's colour. It starts indicating and reading should also be recorded automatically on small screens like the screen of a calculator. All readings should be recorded and lastly mean result can be displayed with comments/remarks about the result.

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