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Assessment of Fertilizer Quality Available in Markets of Faisalabad Division, Pakistan

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Abstract. Even though multidimensional fertilizer quality regulation processes are there, availability of good quality fertilizer is still a challenge. Fake, adulterated and substandard fertilizers are present in the market and being sold. Soil and water testing laboratory for research, Faisalabad under the umbrella of Directorate of Soil Fertility Research Institute (SFRI), Lahore is working as legally authorised laboratory for fertilizer quality testing. A total of 3847 number of fertilizer samples having different compositions during the year 2014-15 to 2018-19 were sampled from the markets/warehouses in Faisalabad division by extension department. Out of 3847 analysed samples, 3636 (94.5%) were declared fit for crop use whereas the remaining 211 (5.5%) were found to be unfit. Out of total unfit samples maximum (40%) were reported from Faisalabad district followed by Jhang and Toba Tek Singh. Least (8%) were reported from Chiniot district. It appears overall that 14.8% adulteration was found in micronutrients followed by miscellaneous category (humic acid, amino acid, bio organo phosphate) where percentage was noted as 14.4%. More than 30% of organic matter compositions received in laboratory were found adulterated. Among phosphorus fertilizers 11.4% single super phosphate (SSP) samples were reported below than the specified limit. 8.1% multinutrient fertilizers having nitrogen, phosphate, potassium (NPK) (liquid/solid), 2.6% sulphate of potash (SOP)/muriate of potash (MOP) and least 0.3% NP and nitrophos samples and none of the calcium ammonium nitrate (CAN) sample was found below the specified limit during the period of review.

Keywords: fertilizer, quality control, crop yield, warehouses, markets

Introduction

The nutrition of the plant is one of the most important factors which plays role to control agricultural production and quality improvement. In intensively growing agricultural lands, the soil becomes very poor in nutrients, therefore, fertilization not only increases efficiency but also helps in obtaining better quality of produce from farming activities.

Synthetic fertilizers mainly contain macro-nutrients as phosphate, nitrate, ammonium and potassium salts as well as micronutrients like zinc (Zn), iron (Fe), manganese (Mn), copper (Cu) and boron (B). The quality of different fertilizers is often tempered by the traders in the market. The application of adulterated fertilizers reduces crop yields significantly because of their low nutrient contents (Nasrin *et al*., 2021). Adulteration usually occurs by mixing sand and crop or weed seeds with fertilizers which results in changes of appearance and concentration of the active analyte in the product. Brick chips, powder of broken glasses, finely ground stones are examples of major contaminants in case of MOP (Khan *et al*., 2013). This could be harmful to plants if exogenous materials mixed into fertilizer are chemicals and in adequate amount to affect growth and development of plant. Fertilizer adulteration affects economic of farmers as fertilizers with low nutrient contents force farmers to buy more fertilizers to get enough crop. Effects on soil health like use of adulterated fertilizers would cause soil poisoning (Choudhary *et al*., 2020). Besides tampering with genuine product, many dealers/distributors are marketing expired or unregistered products also. Some other fertilizer quality issues include substandard packaging and storage conditions at

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warehouses and godown, improper ventilation, poor product handling and misleading, fake, misleading or absent labels, and specifications claiming nutrient contents. Incorrect or substandard chemical composition is also a problem mainly related to the fertilizer products manufactured at local plants.

Quality issues have been reported as major supply constraint in fertilizer markets. Farmers have much interest in purchase of improved quality fertilizer despite their cost. Farmers and other stakeholders involved in fertilizer procurement are not well trained regarding product standard specifications, labelling requirements, nutrient concentration, adulteration, etc. Thus, while purchasing the fertilizer for their crops they cannot judge their quality rather they trust on the country's fertilizer quality control system. A good regulatory system guarantees that only good quality products are manufactured or imported and available in the market.

The growth of fertilizer production and use in Pakistan gave rise to a series of policies and regulation designed in the industry. Initially in 1971 and amended later in 1973, The Provincial Essential Commodity Act (PECA) regulated fertilizer production and marketing under the federal government (Mubarik *et al*., 2015). The Punjab fertilizer (control) order of 1973 further strengthens the power of regulators at the provincial level on the regulatory side. The Punjab fertilizer (control) order, 1973 provides guidelines and regulates quality of fertilizers from manufacture, import and distribution to retail. The order describes the roles of management to make sure availability of good quality fertilizers and farmers access to that products. The policy and regulatory frameworks are important pieces in the overall strategy.

Fertilizer Quality Control Laboratories as a major component of this regulatory system played vital role in determining the concentration and source of fertilizer quality. Laboratory testing determines the amount of each element in the fertilizer product. In fertilizer quality regulation system Soil and Water Testing Laboratory for Research, Faisalabad under the umbrella of Directorate of Soil Fertility Research Institute (SFRI), Lahore is working as legally authorised laboratory (Punjab Fertilizer Control Order, 1973), section 20 for testing products for both advisory and regulatory programmes under anti-adulteration campaign government of Punjab.

Materials and Methods

Procedure of sample collection. The authorized Controllers from Directorate of Agriculture Extension, Government of Punjab collected the fertilizer samples from market as per prescribed procedure given in Punjab fertilizer control order, 1973 (section19). In Faisalabad division, 3847 samples were collected from four districts *i.e*. Faisalabad district, Toba Tek Singh district, Jhang and Chiniot district. Samples of fertilizers for test or analysis were sent to the laboratory in sealed packet, together with copies of the memorandum in FORM-I (Punjab Fertilizer Control Order, 1973) placed in an outer cover by registered post or through a special messenger. Form-I contained comprehensive information pertaining to sample brand name, composition, manufacturer/distributor/importer, dealer, etc.

Sample receiving and preparation. All samples received in the laboratory were critically examined regarding seal (that must be intact, readable and reliable), information given on cloth bag and Form-1, Fig. 1. Samples were allotted unique lab. numbers and recorded all the credentials. After thorough mixing/shaking (in case of liquid) samples a portion was sent to the analyst for relevant analysis and remaining portion was stored under proper storage conditions. Portion sent to the analyst designate a unique code.

Analysis. Different analytical techniques including atomic absorption spectrophotometry (AAS) for analysis of micronutrients, flame photometry for potassium, Kjeldahl method for nitrogen analysis, UV-visible

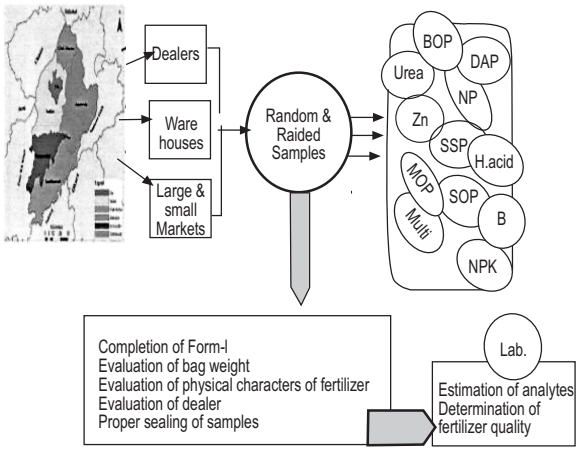

Fig. 1. Generalized system of fertilizer quality assessment in Faisalabad division.

spectroscopy for Boron and titrimetric measurements were employed to analyse the phosphate fertilizers. The analytical samples were prepared in triplicates and each batch includes reference material. The reference materials were used to check the accuracy of the analytical method used. Determination of nitrogen (N), phosphate pentaoxide (P_2O_5) and potassium (K_2O) was followed by the methods AOAC (2016), PSQCA (1996) and incorporated administrative agency, testing methods of fertilizers (Sugiura *et al*., 2014), respectively. Micro-nutrients like Zn was determined by AOAC (2016), Fe by AOAC (2005), Cu by AOAC (2016), Mn by AOAC (2016) and B by AOAC (2016). Soil texture was determined by (Hollis and Turner, 2019), amino acid (FAO, 1970) AOAC (2016) and organic matter by AOAC (2016).

Results and Discussion

After completion of analysis, technically reviewed and approved reports were issued to concerned authorities in a timely and reliable manner according to established guidelines SOPs.

In this study total 3847 number of fertilizer samples of different compositions were received and analysed for quality evaluation during the year 2014-15 to 2018-19 shown in (Fig. 2). Year wise detail of samples analysed is given in (Fig. 3). Five percent (211 out of 3847) of the samples were found adulterated or below the standard values of nutrients indicated/claimed by the manufacturer (Fig. 4) and 95% were found fit or as per standard specifications. Maximum adulteration was found in during the year 2016-17 (Fig. 5) however, the no. was reduced in later years. Number of raided samples was also greater during 2015-16 and 216-17 (Fig. 7).

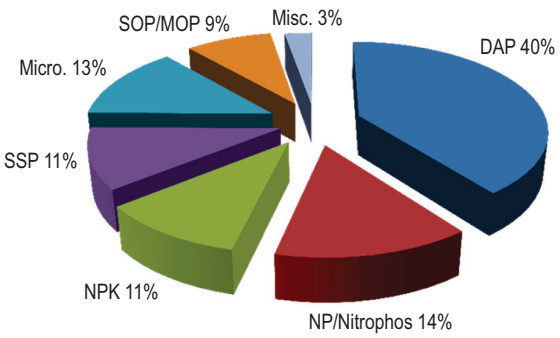

Fig. 2. Percentage distribution of samples collected by fertilizer controllers during the year 2014-15 to 2018-19 from Faisalabad division.

Maximum number of unfit samples were reported from district Faisalabad (40%) followed by Jhang (26%) Toba Tek Singh (25%) and least at Chiniot (9%).

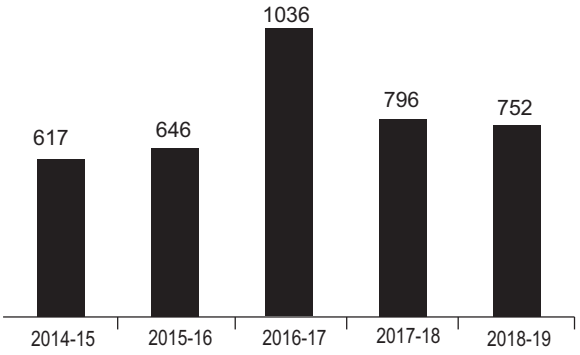

Fig. 3. Total number of samples analysed at laboratory during 2014-15 to 2018-19.

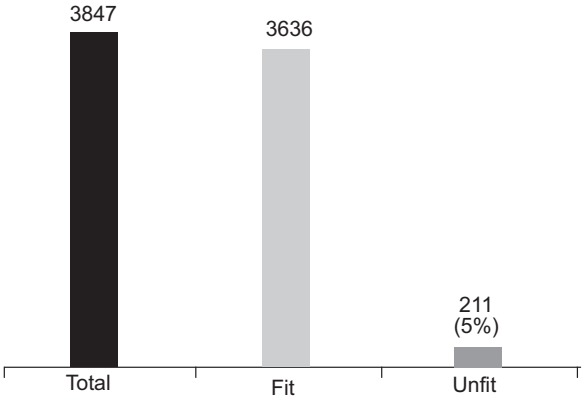

Fig. 4. Classification of samples analysed at laboratory during 2014-15 to 2018-19.

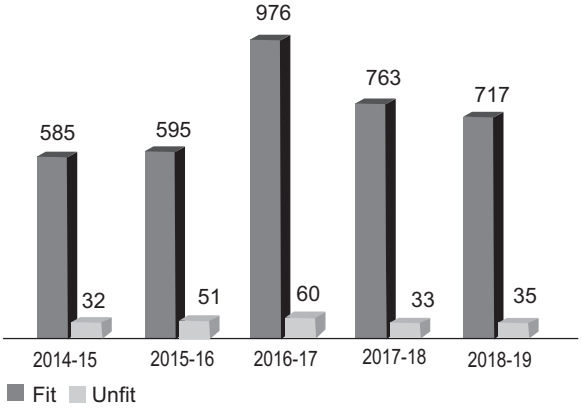

Fig. 5. Year wise classification of samples analysed at laboratory during 2014-15 to 2018-19.

Nutrient wise detail of unfit/adulterated samples in each year is given in Table 1. During the year 2016-17 maximum number of unfit samples were reported followed by the year 2015-16 where the number of unfit samples was 51. During the year 2014 to 2017 maximum quality issue remained with micro-nutrient zinc (solid/liquid) samples marketed in Faisalabad division, same results reported by Soil Resource Development Institute, Dhaka, (SRDI, 2019), where 81% adulteration was reported in zinc sulphate samples. Among phosphate fertilizers maximum adulteration was found in single super phosphate during the 2014 to 2016. During 2016-17 samples of multi micro-nutrients fertilizers having composition Zn, Fe, Cu, Mn, B (soil/liquid) were found below than the standard composition or company claim.

It appears overall that 14.8% adulteration was found in Micronutrients followed by miscellaneous category of fertilizer samples (Humic acid, amino acid, BOP) where percentage was noted as 14.4% (Fig. 6). More than 30% of organic matter compositions received in laboratory during this period were found adulterated. In phosphorus fertilizers 11.4% SSP samples were reported below than the specified limit during 2014 to 2019. Upto 8.0% adulteration was found in the category of NPK (solid/liquid) compositions. A large number of diammmonium phosphate (DAP) fertilizer samples were tested during the period and 1.6% were disqualified. Only 2.6% samples of K_2O were found below the standard values, similarly less adulteration only 1% was reported by Annual Report of (SRDI, 2019). Least adulteration was noted in NP/Nitrophos fertilizer samples (0.3%) and none of the CAN sample was found below the specified limit. Sanabria *et al*. (2018) found same results with samples of fertilizers comprising CAN where no foreign materials or contamination was found in the market of Ugenda (Fig. 8).

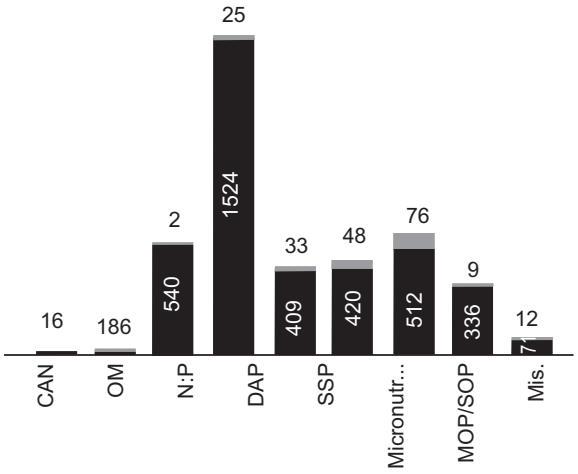

Fig. 6. Product wise total analysed : unfit samples.

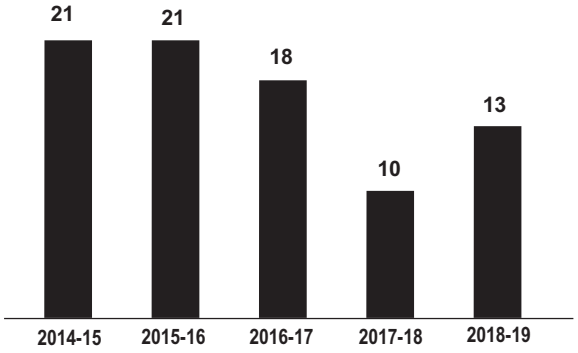

Fig. 7. Number of raided samples sent by fertilizer controllers Govt. of Punjab.

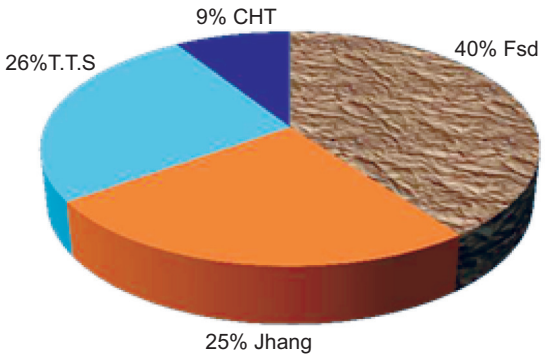

Fig. 8. District wise share of unfit samples.

Table 1. Yearwise detail of unfit samples

Years	SSP	DAP	NP	NPK	K_2O	CAN	Zn	B	Multi-micro-nutrients	H. acid	BOP	OM	Total unfit
2014-15	10	4	-	4	1	-	10	-	-	-	3	-	32
2015-16	20	5	1	9	2	-	10	2	2	-	-	1	51
2016-17	9	4	-	8	2	-	16	2	12	2	-	4	60
2017-18	5	6	-	7	1	-	8	3	-	2	-	1	33
2018-19	4	6	1	5	3	-	3	1	7	4	1	-	35
Total	**48**	**25**	**2**	**33**	**9**	**-**	**47**	**8**	**21**	**8**	**4**	**6**	**211**

Conclusion

The availability of quality fertilizer products in the markets of Faisalabad Division is associated with the collaborative regulatory activities performed by the government institutes (Research and Extension). The more critical and intelligent sampling from markets as well as accuracy in analysis, more will be the probability of access of farmers to the quality products. Out of sampled fertilizers, 95% were found fit for use in field crops in Faisalabad Division.

Apparently quality of products available in market is improving with the passage of time due to: improved regulatory policies implemented through Directorate of SFRI Lahore, Government of Punjab Agriculture Department; accreditation of laboratory for ISO standard 17025:2017 for its testing activities; increased number of Raids.

Furthermore, it is suggested that authorized inspectors should make intelligent sampling without merely focusing on completing the assigned target to ensure better quality of fertilizer being provided to farming community. Agriculture extension workers should train to farmers on how to recognize the originality of fertilizers by some indigenous ways.

Conflict of Interest. The authors declare that they have no conflict of interest.

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