International Journal of Advanced Multidisciplinary Research
ISSN: 2393-8870
www.ijarm.com
DOI: 10.22192/ijamr Volume 5, Issue 9 -2018

Research Article

DOI: http://dx.doi.org/10.22192/ijamr.2018.05.09.002

Evaluation of Deteriorated DAP fertilizer and Recommendation for Sugarcane Crop Production at Beles Sugar Development Project

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Keywords

DAP,
Urea,
phosphorous

Abstract

The evaluation was done to determine whether the deteriorated DAP fertilizer is applicable or not based on the laboratory analysis of major nutrient (P and N) contents at Tana Belles Sugar development project. The store house observation of the Flooded DAP fertilizer was made to fix representative samples.40 representative DAP fertilizers samples were taken and 4 composite samples were made for laboratory analysis based on their strengths of deteriorated. The laboratory analysis result indicated that the deteriorated DAP fertilizer by moisture is highly reduced from 18% N to 11-16 % and 46 % p_2o_5 to 41.22 -45.27% respectively. So the project rather than using 185 kg N and 250 kg urea and DAP apply 222 kg urea and 279 DAP fertilizer respectively.

1. Introduction

A fertilizer is any material of natural or synthetic origin that is applied to the soils or to plants tissue to supply one or more plant nutrients essential to the growth of plants. Among the synthetic fertilizer DAP fertilizer is the world's most widely used phosphorus fertilizer (Bill Grffith, 2017).

DAP is an excellent source of P and N for plant nutrition. It's highly soluble and thus dissolves quickly in soil to release plant-available phosphate and ammonium. Water solubility of DAP fertilizer at 20 ^{0}c is 588 g/l, as the temperature increase solubility increase (web, 2017). Punnu, *et al.* (1985) reported that P role in sugarcane is to stimulate early root formation and development. Application of P, especially on P deficient soils promotes root growth, stimulates tillering, and influences favorable better growth and thereby better yield and juice quality (Bokhtail and Sakurai, 2003)and N content in DAP support the photosynthesis process.

In artificial fertilizers major physical problems observed during handling, storage and use of the artificial fertilizers are caking, dustiness and corrosivity. Caking refers to the formation of a solid mass or lumps of fertilizer material. It is generally caused by the formation of salt or crystal bridges between the fertilizer particles at contact point. Caking is the major physical problem in fertilizer handling and storage. It can be light or severe. In a light caking, the lumps break easily and can be converted into original individual particles. But in extremely severe caking a solid mass becomes hard and cannot broken back down to its original particles (Bill Grffith, 2017).

Moisture is a major menace for the fertilizer industry. Most commercial fertilizers especially, those that have a high concentration of nutrients, are hygroscopic and thus have a high solubility in water. So they readily absorb water vapor or moisture during production, storage and bagging and form a saturated solution leading to caking, oozing, and lumping. .Moisture problem in fertilizer handling is not only caking and lumping but also loss in fertilizer's free flowing properties, loss of physical, nutrient and chemical properties, Health hazards due to ammoniacal fumes of decomposed hygroscopic fertilizers. The end result is often qualitative and quantitative loss (Bill Grffith, 2017).

Beles sugar Development project is one of among recently established sugar project in the country. The project has started sugar cane plantation activity in 2012 E.C. and covered above 13000 ha of land. Even if, the project replaced from DAP fertilizer to blended NPS fertilizer at this time, Beles sugar project were used Urea and DAP fertilizer regardless of soil type. When the project established at the beginning it had plenty of DAP fertilizer which were more than the required amount. Therefore the amount left from the required was not properly handled and even it was stored in very poor store house (personal communication from Beles supply division). Around 358 quintals of DAP fertilizer were flooded in unprecedented/sudden flood. As we observed in the store some bags were dry caked and many of the bags were got light wetted to heavy wetted caked that is difficult to use in cop production. The store house highly toxic with ammonical fumes that released from the flooded DAP fertilizer even the neighboring houses hardly disturbed. This advisory work was performed in order to answer the request raised from the Beles sugar development project whether the damaged DAP fertilizer is applicable or not (appendix1). And Beles research and development center accept the project request to verify the problem as per the procedure. Therefore, the fertilizer assessment study was made with the following objectives:-

1. To assess the major nutrient content in the flooded fertilizer
2. To suggest remedial solution based on the laboratory result

2. Materials and Methods

2.1. Description of the Area

Beles sugar development project is found in Amhara regional state and some part of Benishangul Gumiz regional state at 576 Km distance from Addis Ababa, between $11^0$30’ N and $36^0$41’ E at an average elevation of 1110 m.a.s.l. The area receives 1447 mm mean annual rain fall; and mean maximum and minimum temperature are 32.5 and 16.4 0c, respectively. The soil of the project area is composed of Nitosols, Luvisols, Combisols, Fluvisols, and Vertisols. Vertisols and Luvidols are the most widely spread soils in the project area. The project were used DAP and Urea but currently use NPS and urea fertilizers together.

2.2. Methodology

2.2.1. Store house Observation

Store house observation of flooded DAP fertilizer were made together with research staff and project staffs members. After group visit, close observation of each bag was also made to fix representative samples. Around 40representative samples weretakenand4 composite samples were made for laboratory analysis based on their strength of deteriorated.

Table1. Number of samples

S/N	Sample numbers
1	Sample-1
2	Sample-2
3	Sample-3
4	Sample-4

2.2.2. Analysis of Fertilizer Samples

The fertilizer samples were analyzed for total N and available P following the standard procedures of Sahlemedihn and Taye (2000) at the soil laboratory of Ethiopian Sugar Corporation, Research and Development main center, Wonji.

3. Results and Discussion

Table 2. Laboratory result of Nutrients in Flooded DAP fertilizer

S/N	Lab No	Client's code	TN%	$P_2 o_5$
1	F374	Sample-1	16	43.232
2	375	Sample-2	14	44.3128
3	376	Sample-3	16	45.2392
4	377	Sample-4	11	41.2248
Average			**14.25**	**43.5022**

Most of the sampled fertilizers were highly wetted caked bags and some of the bags were dry caked. As shown on the above table2, the analysis indicated that the available total nitrogen of the fertilizer were ranged from 11 to 16 (mean 13.5). As commonly kwon the normal total nitrogen content in DAP fertilizer is 18 % that mean the deteriorated DAP fertilizer deducted from the normal by 2 to 7 % and the average deduction was 3.75 %.

Available p of surveyed fertilizer bags were ranged from 41.22 to 45.23 % (mean 43.2) but normal total phosphorus nutrient content in DAP fertilizer is 46 %, but as shown on the table 2 the laboratory analysis result indicate that the available total phosphorus of the fertilizer were deducted from the normal by 0.77 to 4.78 % and the average deduction was 2.5 %. So based on the deduction both nitrogen and phosphorus fertilizer calibration were made according to the rating scales of Beles sugar project fertilizer recommendation.

For normal DAP fertilizer, Beles sugar development project were used 250 kg/ha DAP fertilizer for sugar cane production (Zelke and Nestanet, 2015). That means 115 kg /ha p_2O_5 is applied in sugar cane plant whereas, the deteriorated DAP fertilizer the nutrient content is reduced from 0.77 to 4.78 % from the normal in phosphorus nutrient content. By considering lower range as a benchmark from 250 kg flooded dap fertilizer release 103 kg P_2O_5. So between the normal fertilizer and damaged fertilizer there was 12 kg P_2O_5 difference. So to get 115 kg P_2O_5 for a hector of sugar cane plant it need additional 29 kg of damaged DAP fertilizer.

Urea recommendation for plant cane were185 kg/ ha (Zeleke and Nestanet, 2015) in normal DAP fertilizer application that means when the nitrogen content is 18 % in DAP fertilizer, but as shown in table 2 in case of damaged flooded DAP fertilizer the nutrient content of nitrogen was deducted from 2- 7 % from the normal in nitrogen nutrient content, from normal DAP fertilizer 45 kg of total nitrogen released but by considering the lower range as a bench mark released 27.5 kg total nitrogen. So between normal fertilizer and damaged fertilizer there was 17.5 kg total N difference. so to substitute the loss nitrogen it need additional 38 kg urea fertilizer.

3.1. Economic Benefit

The project can cover 128 ha of land by using the deteriorated DAP fertilizer. As the formal information found from Beles sugar development projects supply division one quintal of NPS-Z fertilizer has been bought 1567.60 Ethiopian birr to the project. So in order to cover 128 ha of sugar cane field, 417.28 NPS-Z quintals needed. In order to use the deteriorated DAP fertilizer it should be crushed and some quintals should be formed as a solution form (the moist one which is difficult to give to the plant as a solid form) need lobar to using 358 quintals. So labor coast is accounted in this paper. From our simple observation we observed that to crushing 2 quintals of deteriorated DAP fertilizer need 1 lobar /day, so to crushing 358 quintals it needs 179 labor forces.

The information found from fiancé division one labor /day coasts 52 birr. So to crush 358 quintals it coast around 9308 birr. Finally we can cover 128 ha of sugar cane field and save 644,820 Ethiopian birr by using deteriorated caked DAP fertilizer.

4. Conclusion and Suggestions

4.1. Conclusions

- 279 kg P_2O_5 /ha DAP fertilizer should be applied in split application at planting time and at a time of 2 month with urea application regardless of soil type.
- 222 kg/ha urea should be applied at a time of 2 month regardless of soil type.
- From our observation in the store we observed two form of fertilize that were dry caked and wetted caked DAP fertilizers. Some bags of flooded DAP fertilizer were dry and lumped to use as normal. But the project should be use the drying lumped bags by crushing in the form of granules and applies normal fertilizer application method. Whereas, the wetted caked fertilize should be applied in the solution form either by using irrigation that is fertigation or by using water can with a considerable amount of water because DAP fertilizer is soluble 100 % by water.
- The labor must be wear appropriate protective device including respiratory protection at crushing and application time.

4.2. Suggestions

- To keep the fertilizer in the same condition during storage, it is important to control the moisture changes in the fertilizer.
- Store tightly closed in a dry, cool and well-ventilated place.
- Fertilizer should be protected from adverse weather conditions like rainfall during transportation and storage.
- Accurate fertilizer demand forecasting would be adventitious in marketing fertilizers. It would be helpful in reducing storage time thereby minimizing the losses during storage.
- Fertilizers should be stored in a closed, secure storage place to protect the product from the weather (sun, rain etc.).
- The project should be applied first in first out principle.

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Access this Article in Online	
	Website: www.ijarm.com
Quick Response Code	Subject: Agricultural Sciences
DOI:10.22192/ijamr.2018.05.09.002	

How to cite this article:
Ashebir Getie and Kidane Tekle Michael. (2018). Evaluation of Deteriorated DAP fertilizer and Recommendation for Sugarcane Crop Production at Beles Sugar Development Project. Int. J. Adv. Multidiscip. Res. 5(9): 7-10.
DOI: http://dx.doi.org/10.22192/ijamr.2018.05.09.002