

Original Research Article

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**Soil Test based Fertilizers Recommendation of NPK for Mulberry
(*Morus alba* L.) Farming in Acid Soils of Lohardaga, Jharkhand, India**

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The assessment of fertility status of the soils was carried out in the year 2012-13 at 30 farmers' field from 7 different villages namely Hondaga, Baratpur, Jamgai, Dumari, Nawdiha, Bhauro and Saranatoli villages of Lohardaga district Jharkhand to apply the soil test based recommendation of NPK for Mulberry (*Morus alba* L.) farming in acid soils of Lohardaga, Jharkhand. Application of NPK among farmers' field were categorized into farmers existing practices (FEP), recommended practices (RP) and soil test based fertilizer application (STBFA). STBFA of NPK was applied on the basis of ready reckoner developed by the Central Sericultural Research & Training Institute, Berhampore (Table 1). Based on soil analysis, soils of this area have been characterized as problematic soils. The soil pH among the villages stated above ranged from 4.32 to 5.07 which can be classified as very strong to strong active acidity. The organic carbon content ranged from 0.36 to 0.69 percent which can be reported under low to medium. The available nitrogen content ranged from 119.80 kg ha⁻¹ to 194.67 kg ha⁻¹ whereas available phosphorus and potassium ranged from 10.80 to 15.60 kg ha⁻¹ and 224.44 to 306 kg ha⁻¹ respectively (Table 2). While, going through the leaf yield gain percent among the farmers field in the 7 villages, it was found that, nutrient management under STBFA was highly significant as compare to the FEP followed by RP. The average leaf yield gain was recorded from 10.86 percent to 15.29 percent among the entire farmers field.

Introduction

Mulberry (*Morus spp*) is an economically and traditionally very important deciduous plant for the development of sericulture industry. It belongs to the family Moraceae and is successfully grown under tropical to temperate climatic conditions in various part of the country. Mulberry leaves are basic food material for silkworm *Bombyx mori* L. The nutritious leaves are the most important growth regulating factors for these silkworms, because, being a monophagous insect, they derive almost all the essential nutrients from the mulberry leaves for their survival. Hence, good quality of nutritious mulberry leaves should be feed in abundant quantity for the quality silkworm seed and cocoon production.

It is the well known fact that, the production and productivity of quality mulberry leaves depends on soil health, environmental condition and farm management practices where soil is the mother of whole things and its management practices cannot be ignored or postponed for the survival of life. It is also well known fact that the soil testing is the most effective array in the arsenal of the farmers and planners to detect and deliver the correct doses of nutrients required by the plants.

Keeping the fact in the mind and importance of sericulture industry, this research work were initiated in 2012-13 at 30 farmers' field from 7 different villages of Lohardaga, Jharkhand for the assessment of fertility status to apply the soil test based doses of NPK in Mulberry (*Morus alba* L.) farming.

Materials and Methods

Lohardaga district, the western part of the Ranchi plateau come into existence in 1983. It is bounded by Latehar district in north, Gumla in south and west and Ranchi in the east. It extends from 23⁰16'45'' to

23⁰40'30'' N latitude and 84⁰23'50' to 84⁰56'50' E longitude. Physiologically, the district has been divided into hilly tract and the plateau region. The hilly tract is extended in the west and north western part of the district, whereas the high hill tops of the region is known as pat. The plateau region is the part of the Gumla plateau comprised with entire part of Lohardaga and Bhandra.

Geologically, the area is comprised with Archean granites and gneisses. Alluvium of recent to sub-recent age is also found in the river valley. The main rivers of the districts are South Koel, Sankh, Nandini, Chaupat and Fulijhar etc. Rainfed cultivation is the general agricultural practices in the district. The annual average temperature is 23 °C; the highest temperature goes to 36 °C in summer and lowest of 10 °C in winter. The district receives annual rainfall of 1000 to 1600 mm and it increases from west to east.

The assessment of fertility status of the soils was carried out in the year 2012-13 at 30 farmers' field from 7 different villages namely Hondaga, Baratpur, Jamgai, Dumari, Nawdiha, Bhauro and Saranatoli villages of Lohardaga district Jharkhand to apply the soil test based doses of NPK in Mulberry (*Morus alba* L.) farming. Soil samples were collected, dried, sieved and analyzed by adopting the standard procedure (Black, 1985; Jackson, 1979).

Application of NPK among farmers' field were categorized into farmers existing practices (FEP), recommended practices (RP) and soil test based doses (STBD). STBD of NPK was applied on the basis of ready reckoner developed by the Central Sericultural Research & Training Institute, Berhampore. Leaf yield data was recorded in the month of March, 2013; August, 2013 and October, 2013. There was no regularity

and similarity of farmers existing practices for NPK application, whereas the recommended doses of NPK for rainfed mulberry farming is 150:50:50, hence, the same doses of NPK were applied under recommended practices. Soil Test based doses of NPK is given in Table 1.

Result and Discussion

Fertility Status of Soils

Based on soil analysis, soils of this area have been characterized as problematic soils. The soil pH among the villages stated above ranged from 4.32 to 5.07 which can be classified as very strong to strong active acidity. The organic carbon content ranged from 0.36 to 0.69 percent which can be reported under low to medium. While, analyzing the NPK availability among the soils of these villages, it was found that, the deficiency of these nutrients in this area was also major problem. The available nitrogen content ranged from 119.80 kg ha⁻¹ to 194.67 kg ha⁻¹ whereas available phosphorus and potassium ranged from 10.80 to 15.60 kg ha⁻¹ and 224.44 to 306 kg ha⁻¹ respectively. Details of data regarding fertility status of soils are given in table 2.

Soil pH is the most important soil health indicator and all the nutrient availability chemistry within the soils depends on the soil pH. Soil pH is also considered as master variable in soils, because, it controls many chemical processes that take place. Likewise, organic carbon content is also most important soil health indicator which improves the morpho-physico-chemical properties of soil. While describing the soils health data among the villages as stated in Table 2, it was found that the soils of these villages are highly acidic with low fertility status, hence, the adoption of nutrient management practices was most challenging issue.

Nitrogen is an essential macronutrient needed by all plants to thrive. It is an important component of many structural, genetic and metabolic compounds in plant cells. It is also one of the basic components of chlorophyll, the compound by which plants use sunlight energy to produce sugars during the process of photosynthesis.

Being an essential macronutrient, the availability of nitrogen among these villages are low to medium. Considering the range <272 kg ha⁻¹ 'low', 272-544 kg ha⁻¹ 'medium' and >544 kg ha⁻¹ 'high' (Baruah and Barthakur, 1997), the soils of all the villages have low to medium available nitrogen content.

Next to nitrogen, phosphorus is very important essential nutrients for plant growth and is found in every living plant cell. It is involved in several key plant functions, including energy transfer, photosynthesis, transformation of sugars and starches, nutrient movement within the plant and transfer of genetic characteristics from one generation to the next. Considering the range <22.5 kg ha⁻¹ 'low', 22.5-56.0 kg ha⁻¹ 'medium' and >56.0 kg ha⁻¹ 'high' (Baruah and Barthakur, 1997), the soils of this area was very low to low.

Potassium is third essential macronutrients. Like nitrogen, potassium is absorbed by plants in significantly larger quantities than any other nutrient. It accumulates mainly in vacuole and cytoplasm without forming organic matter in cells and play very important role in the plant metabolism, resistance to lodging, frost, winter-hardiness and prevention from the disease and pests etc.

Considering the range <136.0 kg ha⁻¹ 'low', 136.0-338.0 kg ha⁻¹ 'medium' and >338.0 kg ha⁻¹ 'high' (Baruah and Barthakur, 1997), the soils of this area was low to medium.

Various workers from entire parts of the country reported that the leaching of bases, intensive weathering and sloping landforms was major factors in the variation of pH with depths, physiography and terrace (Ram *et al.*, 2013; Ram *et al.*, 2010; Nayak *et al.*, 2002; Patagundi *et al.*, 1996, Bhadrapur and Seshagiri Rao, 1979). Brady and Weil, (1999) defined, soil organic matter as the summation of plant and animal residues at various stages of decomposition, cells and tissues of soil organisms, and well-decomposed substances, whereas, Woome *et al.*, (1994) opined that, the OC regulates the soil properties.

Albrecht *et al.*, (1997) also stated that, the soil pH, cultural practices and application of manures and fertilizers have had long term effects on soil organic matter by breaking up the organic residues which helps to stimulate the microbial activity and increasing soil organic matter decomposition. He further described that the fertilizer applications can also result in an increase in soil organic matter levels due to greater yields creating a larger return of crop residues to the soil. The combined application of organic manures and inorganic fertilizers increased the organic carbon content in Darjeeling tea soils over the initial values (Singh *et al.*, 2011; Hegde, 1996).

Table.1 Soil Test based doses of NPK

Sl. No.	Village Name	Total No. of farmers covered	Soil test Based Doses of fertilizers		
			Nitrogen	Phosphorus	Potash
1	Hondaga	5	90.37±5.44	62.96±1.41	23.95±0.67
2	Baratpur	5	78.51±10.50	59.53±1.48	31.73±4.55
3	Jamgai	9	57.97±1.58	55.73±1.23	41.95±3.23
4	Dumari	5	58.56±1.01	53.16±1.26	26.99±4.13
5	Nawdiha	2	75.55±0.25	52.40±4.51	22.47±1.48
6	Bhauro	3	60.00±7.61	58.93±2.02	25.27±0.87
7	Saranatoli	1	79.75	58.89	16.91

Table.2 Fertility status of soils

Sl. No.	Village Name	Total No. of farmers covered	Fertility status of soils				
			pH (1:2.5)	Organic carbon (%)	Available N (kg ha ⁻¹)	Available P (kg ha ⁻¹)	Available K (kg ha ⁻¹)
1	Hondaga	5	4.57±0.11	0.38±0.04	119.80±13.87	10.80±1.56	302.20±2.92
2	Baratpur	5	4.32±0.19	0.49±0.04	149.60±20.69	11.40±1.08	269.20±18.69
3	Jamgai	9	4.72±0.07	0.50±0.03	194.67±4.21	13.89±0.73	224.44±11.85
4	Dumari	5	4.97±0.02	0.45±0.09	192.80±2.71	15.60±0.75	288.20±16.36
5	Nawdiha	2	4.99±0.02	0.36±0.07	148.50±2.89	15.50±2.50	306.00±8.00
6	Bhauro	3	5.07±0.07	0.52±0.01	189.00±19.67	11.67±1.33	294.67±3.53
7	Saranatoli	1	4.78	0.69	163.0	12.0	229.0

Table.3 Leaf Yield data

Sl. No.	Village Name	No.of farmers	March	August	October	Total	March	August	October	Total	March	August	October	Total	Yield gain in recommended (%)	Yield gain in STBFA (%)
			Leaf yield (mt ha ⁻¹) in existing practices				Leaf yield (mt ha ⁻¹) in recommended practices				Leaf yield (mt ha ⁻¹) in STBFA					
1	Hondaga	5	2.76±0.06	2.94±0.05	2.85±0.04	8.54±0.07	2.93±0.05	3.10±0.02	3.08±0.01	9.12±0.06	3.02±0.05	3.17±0.03	3.17±0.02	9.36±0.10	3.56±0.51	10.86±0.86
2	Baratpur	5	2.77±0.07	2.79±0.05	2.75±0.04	8.31±0.10	2.99±0.05	3.09±0.04	3.05±0.04	9.12±0.09	3.08±0.05	3.17±0.05	3.13±0.02	9.38±0.10	2.80±0.36	12.72±2.15
3	Jamgai	9	3.00±0.05	3.13±0.10	2.94±0.08	9.06±0.16	3.06±0.03	3.10±0.07	3.09±0.05	9.25±0.10	3.13±0.04	3.14±0.06	3.10±0.06	9.36±0.11	3.39±0.39	11.45±0.96
4	Dumari	5	3.00±0.04	2.94±0.04	2.83±0.06	8.77±0.12	3.16±0.02	3.18±0.02	3.10±0.03	9.45±0.06	3.25±0.01	3.28±0.02	3.23±0.03	9.76±0.04	3.30±0.25	11.29±0.98
5	Nawdiha	2	3.01±0.02	2.87±0.06	2.68±0.01	8.56±0.03	3.13±0.01	3.14±0.03	3.10±0.04	9.37±0.06	3.23±0.01	3.22±0.02	3.18±0.02	9.64±0.04	2.86±0.31	12.59±0.01
6	Bhauro	3	3.00±0.10	2.84±0.07	2.76±0.05	8.60±0.20	3.20±0.02	3.20±0.02	3.11±0.01	9.50±0.03	3.28±0.02	3.27±0.01	3.22±0.01	9.76±0.03	2.68±0.15	13.62±2.55
7	Saranatoli	1	3.12	2.70	2.69	8.50	3.21	3.20	3.15	9.56	3.31	3.27	3.23	9.80	2.55	15.29

Vijay Kumar *et al.*, (1994) reported that, the low availability of phosphorus may be due to fixation of released phosphorus by clay minerals and oxides of Fe and Al whereas various workers from all over the country also reported that the availability of potash in the soils depends on weathering of K bearing minerals and also release of K from organic residues (Rao *et al.*, 2008).

Mulberry Leaf Yield

While studying the season and village wise leaf yield data, it was found that, the average higher leaf yield was recorded in all the villages during entire crop season i.e. March, August, and October by applying the STBD of NPK followed by RP and FEP. The higher leaf yield 9.12 mt ha⁻¹ was recorded in the Hondaga village with the application of soil test based doses of fertilizer application (STBFA) followed by 9.36 mt ha⁻¹ in recommended practices (RP) and 8.54mt ha⁻¹ in farmers existing practices (FEP). In the Bratpur farmer's field, the maximum leaf yield was recorded 9.38 mt ha⁻¹ in STBFA, 9.12 mt ha⁻¹ in RP and 8.31 mt ha⁻¹FEP. The leaf yield data of Jamgai farmers was also similar and it was 9.36 mt ha⁻¹ in STBFA, 9.25 mt ha⁻¹ in RP and 9.06 mt ha⁻¹ FEP.

In Dumari farmers maximum leaf yield was recorded 9.76 mt ha⁻¹ in STBFA, 9.45 mt ha⁻¹ in RP and 8.77 mt ha⁻¹ in FEP. In Nawdiha farmers maximum leaf yield was recorded 9.64 mt ha⁻¹ in STBFA, 9.37 mt ha⁻¹ in RP and 8.56 mt ha⁻¹ in FEP. In Bhauro farmers maximum leaf yield was recorded 9.76 mt ha⁻¹ in STBFA, 9.50_ mt ha⁻¹ in RP and 8.60 mt ha⁻¹ in FEP. In Saranatoli farmers maximum leaf yield was recorded 9.8 mt ha⁻¹ in STBFA, in recommended practices 9.56 mt ha⁻¹ & 8.50 Leaf yield (mt ha⁻¹) in existing practices was recorded.

While, going through the leaf yield gain percent among all the villages, it was found that, nutrient management under STBFA was highly significant as compare to the FEP followed by RP. The average leaf yield gain was recorded from 10.86 percent to 15.29 percent among the entire farmers field.

It can be concluded that the soil test based doses of fertilizers were most efficient and it was beneficial to increase the yield and quality of mulberry leaves.

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