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Impact of basal dose of primary nutrients on the nutrient status of soil used for lac production

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Abstract
Soil test based nutrient management has emerged as a key subject in efforts to increase agricultural output. Two year experimental trail (2013-14 and 2014-15) was carried out on *Zizyphus mauritiana* at lac grower's field in the village Panwas Tolla, Block Barghat, District Seoni, Madhya Pradesh, India to evaluate the impact of Basal dose of Primary Nutrients on the nutrient status of Soil used for lac Production. The present study leads us to the conclusion that application of basal dose of nutrients has a positive impact on the nutrient's status of soil.

Keywords: lac, soil analysis, nutrients

Introduction

The soil fertility can be enhanced by using fertilizers. Use of fertilizers has been reported to increase the crop yield (Kang and Juo, 1979; Kang and Nangju, 1983; Kutu *et al*., 2009) [8, 9, 11]. Addition of appropriate fertilizers to plants leads to remarkable improvement in both quantity and quality of plant growth (Aziz, 2007) [2]. Plants on the other hand provide food and shelter to majority of insects (Mello and Filho, 2002) [13]. Growth of plants as well as insects is interdependent in many ways (Panda and Khush, 1995) [15]. Development of plants depends on nutrient availability while that of insects depends on the quality of food available from its host plants (McGuinness, 1987; Gogi *et al*., 2012) [12, 6]. Therefore the application of nutrients to plants is likely to increase the performance of herbivores insects. Soil test based nutrient management has emerged as a key matter in efforts to augment agricultural productivity and production since optimal use of nutrients, based on soil analysis can improve crop productivity and minimize wastage of these nutrients. The present research was therefore conducted to evaluate the impact of Basal dose of primary nutrients on the nutrient status of soil used for lac production.

Methodology

The present study was conducted during the year 2013-14 and 2014-15 on *Z. mauritiana* trees in lac grower's field in the village Panwas Tolla, Block Barghat, District Seoni, Madhya Pradesh, India. Geographically the village is located between 21°55'51"N latitude and 79°45'49"E longitude. The present trial was planned in randomized block design (RBD) with four treatments (T_1-N, T_2-NP, T_3-NPK and T_4-control) having six replications. The fertilizers were applied as per recommendations (Paul *et al*., 2013) [16] during the two year study period. The sampling sites for the soil collection were selected randomly in such a way that the whole field was covered. The samples were collected from each treatment. The surface debris at each sampling site was removed with *Khurpi* or spade. The samples for each treatment were then collected from selected sampling site with the help of the sampling tool (Auger) and collected in a plastic bowl. These samples are known as primary samples (Kulhare, 2011) [10]. The primary samples of each treatment brought to the laboratory were then air dried. Air dried samples were grinded and sieved for uniform size and free of stone, soil aggregates less than 1 cm (Singh *et al*., 1999) [18]. Small quantities of soil sample were taken from well homogenized primary samples to make a composite sample of the particular treatment. The composite soil sample of each treatment sealed in polythene bags 6″x9″ with 0.13 mm thickness labeled with water proof inks were then transferred to the laboratory for analysis (Pitard, 1987) [17].

The soil analysis for macronutrients (N, P and K) was done from the Soil Laboratory of Department of Soil Science and Agricultural Chemistry, Jawaharlal Nehru Krishi Vishwavidyalaya Jabalpur, M.P. Total N was estimated by the micro-Kjeldahl method as per procedure suggested by AOAC (1995). Available soil P was analyzed according to the standard procedure of Olsen *et al.*, (1954) [14]. The available potassium i.e. exchangeable and water soluble potassium was determined by extracting soil with neutral normal ammonium acetate solution. The estimation of potassium was carried out by flame photometer (Black, 1965) [3].

Results

The soil sampling was done thrice in each season i.e. one month before fertilizer application, during growth period of lac and after harvesting of lac. The results of the soil analysis are presented in Table-1. In case of treatment T_1, the pH of the soil before fertilizer application was 6.36 while it was 7.04 and 6.53 during growth period and after harvesting of lac respectively. The EC (dS m^{-1}) of the soil was 0.1 before fertilizer application while it was 0.21 and 0.15 during growth period and after harvesting of lac crop respectively. The OC (g kg^{-1}) of the soil was 3.10 before fertilizer application while it was 2.87 and 2.36 during growth period and after harvesting of lac crop respectively. The average Nitrogen in the soil was 235.5 before fertilizer application which went upto 246 during the growth period of lac indicating the effect of fertilization and then decreases to 230.5 after harvesting of lac crop. There was 4.46 percent increase in the available Nitrogen in soil in response to fertilizer application in treatment T_1.

In case of treatment T_2, the pH of the soil before fertilizer application was 6.18 while it was 6.32 and 6.34 during growth period and after harvesting of lac respectively. The EC (dS m^{-1}) of the soil was 0.1 before fertilizer application while it was 0.1 and 0.1 during growth period and after harvesting of lac crop respectively. The OC (g kg^{-1}) of the soil was 2.72 before fertilizer application while it was 2.69 and 2.53 during growth period and after harvesting of lac crop respectively. The average Nitrogen in the soil was 217 before fertilizer application which increased to 235 during the growth period of lac indicating the impact of fertilizer application while it was 244.5 after harvesting of lac crop. The average Phosphorous in the soil was 23.1 before fertilizer application which went upto 30.45 during growth period of lac suggesting mining and then decreased to 26.65 after harvesting of lac. There were 8.29 and 31.82 percent increase in the available Nitrogen and Phosphorous respectively after fertilizer application in treatment T_2.

In treatment T_3, the pH of the soil before fertilizer application was 6.23 while it was 6.21 and 6.07 during growth period and after harvesting of lac respectively. The EC (dS m^{-1}) of the soil was 0.09 before fertilizer application while it was 0.08 and 0.12 during growth period and after harvesting of lac crop respectively. The OC (g kg^{-1}) of the soil was 2.57 before fertilizer application while it was 3.08 and 2.88 during growth period and after harvesting of lac crop respectively. The average Nitrogen in the soil was 216.5 before fertilizer application which increased to 253.5 during the growth period of lac showing the effect of fertilizers application while it was 249 after harvesting of lac crop. The average Phosphorous in the soil was 29.9 before fertilizer application while it was 27.75 and 14.95 during growth period and after harvesting of lac respectively. The average Potassium in the soil was 240.5 before fertilizer application which went upto 283.5 during growth period of the lac while it was 296.5 after harvesting of the lac crop. There were 17.09 and 17.87 percent increase in the available Nitrogen and Potassium respectively after fertilizer application while Phosphorous showed a decline of 7.74 percent in the treatment T_3.

In treatment T_4, the pH of the soil before fertilizer application was 6.48 while it was 6.40 and 6.06 during growth period and after harvesting of lac respectively. The EC (dS m^{-1}) of the soil was 0.08 before fertilizer application while it was 0.08 and 0.24 during growth period and after harvesting of lac crop respectively. The OC (g kg^{-1}) of the soil was 2.53 before fertilizer application while it was 2.46 and 3.15 during growth period and after harvesting of lac crop respectively. The average Nitrogen in the soil was 194 before fertilizer application while it was 235.5 and 245.5 during the growth period and after harvesting of lac crop. The average Phosphorous in the soil was 24.9 before fertilizer application which went down to 22.45 during growth period while it was 27.5 after harvesting of lac crop. The average Potassium in the soil was 275 before fertilizer application which decreased to 268 during growth period of the lac while it was 273.5 after harvesting of the lac crop. There was 10.91 and 2.61 percent decrease in the available Phosphorous and Potassium in case of control treatment while available Nitrogen showed 21.39 percent increase in case of T_4.

Table 1: Soil sample analysis of the treatment plots

Treatments	**T_1**			**T_2**			**T_3**			**T_4**		
Particulars	**Before fertilizer application**	**Growth period of lac crop**	**After harvesting of lac crop**	**Before fertilizer application**	**Growth period of lac crop**	**After harvesting of lac crop**	**Before fertilizer application**	**Growth period of lac crop**	**After harvesting of lac crop**	**Before fertilizer application**	**Growth period of lac crop**	**After harvesting of lac crop**
pH	6.36	7.04	6.53	6.18	6.32	6.34	6.23	6.21	6.07	6.48	6.40	6.06
EC (dS m^{-1})	0.10	0.21	0.15	0.10	0.10	0.10	0.09	0.08	0.12	0.08	0.08	0.24
OC (g kg^{-1})	3.10	2.87	2.36	2.72	2.69	2.53	2.57	3.08	2.88	2.53	2.46	3.15
Av. N	235.50	246.00	230.50	217.00	235.00	244.50	216.50	253.50	249.00	194.00	235.5	245.50
Av. P	20.95	25.45	28.80	23.10	30.45	26.65	29.90	27.75	14.95	24.9	22.45	27.50
Av. K	244.50	232.50	268.50	254.00	250.00	277.00	240.50	283.50	296.50	275.00	268.00	273.50

Discussion

Nutrient availability, either due to soil nutrient concentration or fertilization, affects nutrient distribution in plant tissues (Grove *et al*., 1996). Fertilization alters the concentration of Nitrogen, Phosphorous and Potassium. In the present investigation, the average Nitrogen in all the treated plots increased after fertilizer application. Similarly, the amount of average Phosphorous also increased in response to application of Phosphorous except in T_3 that showed a slight decline which may be due to higher demand of Phosphorus in those plants that ultimately leads to its decline. The average Potassium of the soil also increased which may be credited to the application of the Potassium in treatment T_3. In case of treatment T_4, the average Nitrogen of the soil during the growth period of the lac showed an increase while the Average Phosphorous and Potassium showed a decline during the growth period of lac when compared to the average Phosphorous and Potassium before fertilizer application which may be a consequence of no fertilizer applied in case of treatment T_4. The increase in average available Nitrogen may be due to soil organic matter additions, soil microorganism activity and temperature and moisture level. Soil testing for nitrogen has limited use because the nitrogen level constantly changes in response to soil organic matter additions, soil microorganism activity and temperature and moisture level (Whiting *et al*., 2014) [19].

The mean pH value of soil in the study area at different time periods of the soil analysis indicated that the soil was slightly acidic in nature except during the growth period of lac in treatment T_1 which was slightly alkaline. The major effect of soil acidification on plants included the decline in nutrient supply, increased concentration of metal ions in solution, especially of aluminum, copper and manganese, which may be toxic (Dorraji *et al*., 2010) [5]. The pH range in the present case is conducive for the growth of a wide range of plants as only at about pH values below 4.2 that the H^+ ions in the soil can stop or even reverse nutrient uptake by roots (Black, 1967) [4].

Total soluble salts were estimated from electrical conductivity (EC) of aqueous soil extracts. Standard value of EC in soil are Normal- less than 0.8 dsm^{-1}, critical for salt tolerant crops- 1.6-2.5 dsm^{-1}, Injurious to most crops- more than 2.5 dsm^{-1} (Jain *et al*., 2014) [7]. The EC value in the present case ranged between 0.08 to 0.24 dSm^{-1} in different treatments which is conducive for the normal growth of plants.

Soil organic carbon (OC) is one of the most important constituents of soil due to its capability to affect plant growth because of its nutrient and water holding capacity. The organic carbon of soil in the present case ranged between 2.36 to 3.15 in different treatments at different time period of soil sampling which is high range. Standard value of OC are low- less than 0.50, medium- 0.50- 0.75 and high- more than 0.75 (Jain *et al*., 2014) [7].

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