International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
www.chemijournal.com
IJCS 2020; 8(4): 3218-3220

Received: 13-05-2020
Accepted: 15-06-2020

Comparative studies of uptake of N, P and K influenced by different treatment

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DOI: https://doi.org/10.22271/chemi.2020.v8.i4an.10149

Abstract

The experiment was conducted during 2016-17 at Crop Research Centre of Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut (U.P.) to evaluate the Comparative production potential of forage based cropping sequences and their economic feasibility in western plain zone of U.P. The field experiment was consisted of 6 treatments as cropping sequences and they were tested in randomized block design with 4 replications viz. Sorghum(F) – Berseem - Maize(F) + Cowpea(F), Sorghum(F) + Guar(F) - Oat(F) - Maize(F) - Cowpea(F), Sorghum(F) + Cowpea(F) - Barley(F) - Maize(F) + Cowpea(F), Rice-Wheat - Maize(F) + Cowpea(F), Rice – Berseem - Sorghum(F), Sorghum(F) + Cowpea(F) – Wheat - Sorghum(F) + Cowpea(F).

Among six crop sequences Sorghum(F) – Berseem - Maize(F) + Cowpea(F) was observed highest total nitrogen uptake (620.55 kg $ha^{-1}year^{-1}$) among all cropping sequence. The second highest total nitrogen uptake (520.98 kg $ha^{-1}year^{-1}$) was recorded in the crop sequence Rice – Berseem - Sorghum(F). Rice – Berseem - Sorghum(F) was recorded total phosphorus uptake (144.24 kg $ha^{-1}year^{-1}$) among all the cropping sequence. Sorghum(F) – Berseem - Maize(F) + Cowpea(F) recorded highest total potassium uptake (608.68 kg $ha^{-1}year^{-1}$) in all the cropping sequence while the second highest total potassium uptake was recorded in the sequence Rice – Berseem - Sorghum(F) (549.15 kg $ha^{-1}year^{-1}$). Among all the cropping sequences the highest total nitrogen, phosphorus and potassium uptake (1368.94 kg $ha^{-1}year^{-1}$) was recorded in the crop sequence Sorghum(F) – Berseem - Maize(F) + Cowpea(F). However, the minimum total nitrogen, phosphorus and potassium uptake (594.41 kg $ha^{-1}year^{-1}$) was recorded in the crop sequence Sorghum(F) + Cowpea(F) – Wheat - Sorghum(F) + Cowpea(F).

Keywords: Cropping sequence, influence, uptake

Introduction

Livestock population is the largest in India comprising 182.50 million cattle, among these, 61.30 million buffaloes, 76.65 million goats, 41.30 million sheep, 10.0 million pigs and 3.04 million other animals. (Jat *et al*., 2014) [2]. India is having the largest livestock population, 15% of the world's livestock population (Neelar, 2011) [5]. Livestock contributing 7% to national GDP and source of employment and ultimate livelihood for 70% population in rural areas. Deficiency in feed and fodder has been identified as one of the major components in achieving the desired level of livestock production (Devi *et al.*, 2014) [1]. The patterns of deficit values are different in different parts of the country. At present, the country faces a net deficit of 63% green fodder, 24% dry crop residues and 64% feeds (Kumar *et al.*, 2012) [3] as against the requirement of 1025, 570 and 123 million tonnes and state faces a deficit of 46.5, 32.4 and 69.3% green fodder, dry fodder and concentrates, respectively as against the requirement of 313, 62.6 and 14.3 million tonnes, respectively for current livestock population. The deficit and supply in crude protein (CP) and total digestible nutrient (TDN) are 34.18 and 262.02 million tonnes as against the 47.76 and 344.93 million tonnes in India, which is not economical to transport over long distances. It reveals a huge deficit of green fodder prevailing 390 MT and is expected to rise 1025 MT (MOA, 2011) [4]. The productivity of our livestock often remains low due to inadequate and nutritionally unbalanced supply of feed and fodder.

Due to ever increasing population pressure of human beings, arable land is mainly used for food and cash crops, thus there is little chance of having good – quality arable land available for fodder production, unless milk production becomes remunerative to the farmer as compared to other crops. To meet the current level of livestock production and its annual growth in population, the deficit in all components of fodder, dry residues and feed has to be met from either increasing productivity, utilizing untapped feed resources, increasing land area (not possible due to human pressure for food crop) / imports or through manipulating cropping sequences.

Efficient utilization of limited land resources and other agricultural imports for obtaining the best from the harvest in the form of herbage per unit area and time is the primary objective of intensive forage production system. An ideal system, besides giving higher yields and making the maximum use of available resources, must have favourable effect on soil productivity and provide sustainability to the production system. In fact, intensive cropping is the only alternative to boost forage yield from irrigated lands and overall productivity which covers about 30% of the cultivated area in the country. The multi-cut nature and flexibility in manipulating the duration for several forage species are desirable traits to increase cropping / harvesting frequency.

Therefore, there is need for increasing forage production within existing farming system and utilization of marginal, sub marginal dry lands and problem soils for developing need for fodder resources in order to get year round forage and economise livestock feeding management. An integral approach of food-fodder production aims at obtaining food as well as fodder concurrently from the same piece of land. In view of this it would be desirable it a more profitable and economically viable sequence could be introduced under western Uttar Pradesh situation for long term productivity and sustainability of the system.

Materials and Methods

The experiment was conducted at Crop Research Centre of Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut (U.P.) during 20016-17. Meerut is located on the Delhi-Dehradun highway. Geographically it is located at 90^0 04, N latitude and 77^0 42 ‘E longitude at an altitude of 237 meters above the mean sea level. The area lies in the heart of the Western Uttar Pradesh which has sub-tropical climate. The field experiment was consisted of 6 treatments as cropping sequences and they were tested in randomized block design with 4 replications.

Plant analysis

Nitrogen, phosphorus and potassium contents were analysed in plant sample at the harvest of the crop by adopting modified micro-kjeldhal method for nitrogen, vanado-molybdate yellow colour method for phosphorus and flame photometer method for potassium as described by Jackson (1973).

Nitrogen

In plant the total nitrogen was determined by kjeldhals method. In a digestion tube 0.5 g finally powdered plant samples was taken and added 10 ml of concentrated H_2SO_4 + 1 g digestion mixture (K_2SO_4 + $CuSO_4.5H_2O$), and kept for overnight, than heating was done in digestion chamber till the clear colourless solution appears. Cooled digest was shifted to distillation unit. The content was distilled for 10 minutes using 40% NaOH and distillate was finally titrated against standardized H_2SO_4, once the colour change from bluish green to permanent pale pink colour note the burette reading.

Digestion for P and K sample

0.5 g dried powdered plant samples was taken in a digestion tube and 10ml of di-acid mixture (9:4 HNO_3:$HClO_4$) was added and kept for overnight. It was than digested on a black digester till the colourless solution was obtained. The flask was cooled and 25ml of distilled water added into solution after than the solution was filtrated into a 50ml of volumetric flask and makeup volume by distilled water.

Colour develop for P

5 ml of aliquot was taken into 50 ml volumetric flask and 10 ml of vandate-molybdate solution were added and diluted to 50 ml mixed well and read the intensity of yellow colour on spectrophotometer by using blue filter at 420 nm wavelength a blank reading was also run without sample simultaneously (Jackson, 1967).

Potassium

For determination of K digested extract was used directly with flame-photometer. The potassium content in digest sample is determined by using flame-photometer.

The nutrient uptake (kg ha^{-1}) was calculated by using their nitrogen, phosphorus, potassium content values and dry matter of crop plant on hectare basis.

$$\text{Nutrient uptake (kg ha}^{-1}\text{)} = \frac{\text{Nutrient content (\%) x Dry matter of crop (kg ha}^{-1}\text{)}}{100}$$

Result and Discussion

Total nitrogen uptake

The highest total nitrogen uptake (620.55 kg $ha^{-1}year^{-1}$) was observed significantly higher in crop sequence T_1 i.e. Sorghum(F) – Berseem - Maize(F) + Cowpea(F). The second highest total nitrogen uptake (520.98 kg $ha^{-1}year^{-1}$) was recorded in the crop sequence T_5 i.e. Rice – Berseem - Sorghum(F), which was at par to the crop sequence T_2 - Sorghum(F) + Guar(F) - Oat(F) - Maize(F) + Cowpea(F) (502.24 kg $ha^{-1}year^{-1}$). However, the minimum total nitrogen uptake (283.68 kg $ha^{-1}year^{-1}$) was noticed under crop sequence T_6 i.e. Sorghum(F) + Cowpea(F) – Wheat - Sorghum(F) + Cowpea(F), which was at par to the crop sequence T_3 - Sorghum(F) + Cowpea(F) - Barley(F) - Maize(F) + Cowpea(F) (284.41 kg $ha^{-1}year^{-1}$).

Total phosphorus uptake

Total phosphorus uptake (144.24 kg $ha^{-1}year^{-1}$) was recorded significantly higher in crop sequence T_5 i.e. Rice – Berseem - Sorghum(F), which was at par to crop sequence T_1- Sorghum(F) – Berseem - Maize(F) + Cowpea(F) (139.71 kg $ha^{-1}year^{-1}$). However, the lowest total phosphorus uptake (52.12 kg $ha^{-1}year^{-1}$) was recorded in crop sequence T_2 i.e. Sorghum(F) + Guar(F) - Oat(F) - Maize(F) + Cowpea(F). The crop sequence T_6 – Sorghum(F) + Cowpea(F) – Wheat - Sorghum(F) + Cowpea(F) (57.23 kg $ha^{-1}year^{-1}$), T_3 - Sorghum(F) + Cowpea(F) - Barley(F) -Maize(F) + Cowpea(F) (57.20 kg $ha^{-1}year^{-1}$) and T_2 - Sorghum(F) + Guar(F) - Oat(F) - Maize(F) + Cowpea(F) (52.12 kg $ha^{-1}year^{-1}$) was at par to each other.

Total potassium uptake

The highest total potassium uptake (608.68 kg $ha^{-1}year^{-1}$) was recorded in the crop sequence T_1 i.e. Sorghum(F) – Berseem - Maize(F) + Cowpea(F), which was significantly superior over rest of treatments. The second highest total potassium uptake was recorded in the sequence T_5 i.e. Rice – Berseem - Sorghum(F) (549.15 kg $ha^{-1}year^{-1}$) followed by T_2 - Sorghum(F) + Guar(F) - Oat(F) - Maize(F) + Cowpea(F) (469.54 kg $ha^{-1}year^{-1}$). The crop sequence T_4 - Rice – Wheat -

Maize(F) + Cowpea(F) (349.92 kg ha^{-1}year^{-1}) and T_3 - Sorghum(F) + Cowpea(F) - Barley(F) -Maize(F) + Cowpea(F) (325.92 kg ha^{-1}year^{-1}) was at par to each other. The minimum total potassium uptake (253.50 kg ha^{-1}year^{-1}) was noticed under the crop sequence T_6 i.e. Sorghum(F) + Cowpea(F) – Wheat - Sorghum(F) + Cowpea(F).

Total nitrogen, phosphorus and potassium uptake

Among all the cropping sequences the highest total nitrogen, phosphorus and potassium uptake (1368.94 kg ha^{-1}year^{-1}) was recorded in the crop sequence T_1 i.e. Sorghum(F) – Berseem - Maize(F) + Cowpea(F), which was significantly superior over rest of treatments. However, the minimum total nitrogen, phosphorus and potassium uptake (594.41 kg ha^{-1}year^{-1}) was recorded in the crop sequence T_6 i.e. Sorghum(F) + Cowpea(F) – Wheat - Sorghum(F) + Cowpea(F), which was at par to the crop sequence T_3 i.e. Sorghum(F) + Cowpea(F) - Barley(F) - Maize(F) + Cowpea(F) (667.53 kg ha^{-1}year^{-1}). The crop sequence T_4 - Rice – Wheat - Maize(F) + Cowpea(F) (787.97 kg ha^{-1}year^{-1}) and T_3 - Sorghum(F) + Cowpea(F) - Barley(F) -Maize(F) + Cowpea(F) (667.53 kg ha^{-1}year^{-1}) was at par to each other.

Table 1: Effect of different forage based cropping sequence on total nitrogen, phosphorus and potassium uptake (kg ha^{-1}year^{-1})

Treatments	Nitrogen	Phosphorus	Potassium	Total NPK uptake (kg ha^{-1}year^{-1})
T_1 – Sorghum(F)-Berseem-Maize(F)+Cowpea(F)	620.55	139.71	608.68	1368.94
T_2 – Sorghum(F)+Guar(F)-Oat(F)-Maize(F)+Cowpea(F)	502.24	52.12	469.54	1023.90
T_3 – Sorghum(F)+Cowpea(F)-Barley(F)- Maize(F)+Cowpea(F)	284.41	57.20	325.92	667.53
T_4 - Rice-Wheat- Maize(F)+Cowpea(F)	361.85	76.20	349.92	787.97
T_5 - Rice-Berseem-Sorghum(F)	520.98	144.24	549.15	1214.37
T_6 – Sorghum(F)+Cowpea(F)-Wheat- Sorghum(F)+Cowpea(F)	283.68	57.23	253.50	594.41
SEm±	17.70	3.71	17.40	38.63
CD at 5%	56.51	11.85	55.53	123.31

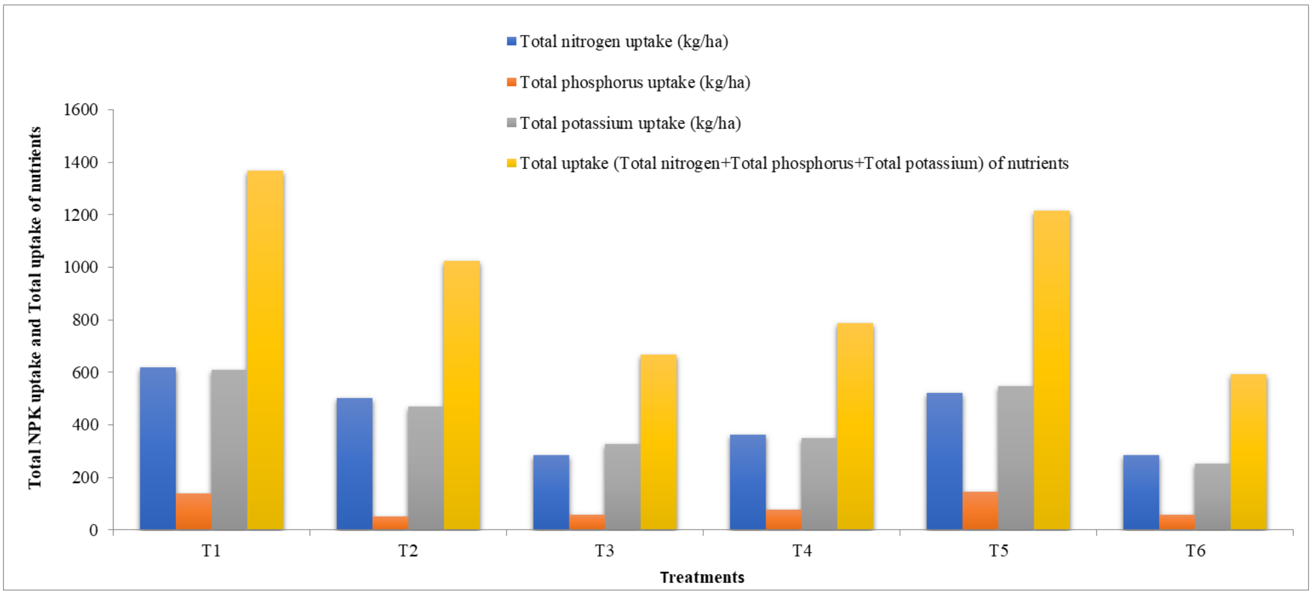

Fig 1: Effect of different forage based cropping sequence on total nitrogen, phosphorus and potassium uptake (kg ha-1year-1)

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