Original Research Article

Effect of different organic and inorganic fertility sources on protein contentin pearlmillet crop grown in sandy soils

ABSTRACT

A field trial conducted at the Agronomy farm, S.K.N. College of Agriculture, Jobner. The six treatments are comprising integrated nitrogen management (control, 100% RDN, 75% RDN + 25% N through FYM, 50% RDN + 50% N through FYM, 25% RDN + 75% N through FYM and 100% N through FYM) and four levels of liquid organic manures (control, panchagvya, vermiwash and cow Urine) given respectively to main and sub plots remained replicated thrice in Split Plot Design. Pearlmillet variety 'RHB 223' was used as a test crop. Results presented that integrated nitrogen management had a helpful impact on pearlmillet crop performance then their residual effect on mustard variety Giriraj (DRMR IJ-31). The integrated nitrogen management dramatically increased SOC and better-quality soil health in terms of physical and chemical qualities, in accumulation to higher crop routine. Between the various treatments, application of 25% RDN + 75% N through FYM to pearlmillet and application of 50% RDN + 50% N through FYM their residual effect to mustard crop increased the quality content and crop performance enhanced soil physico-chemical properties and reflected as viable method in improving soil nutrient availability on sustainable basis.

Keywords - Integrated nitrogen management, Liquid organic manures, Protein content, Pearlmillet, Residual effect, Mustard

INTRODUCTION

India is the foremost producer of pearlmillet in the world occupying 6.70 million hectares (mha) with an average production of 9.62 million tonnes (mt) and productivity of 1436 kg/ha during 2021-22 [2]. More than 80% of the area further down pearlmillet falls in arid and semi - arid region of the country. Rajasthan, Uttar Pradesh, Maharashtra, Haryana and Gujarat account for more than 90% of total area and production. Rajasthan occupied first position in area and

production of pearlmillet. In India, mustard is predominantly cultivated in the states of Rajasthan, Uttar Pradesh, Haryana, Madhya Pradesh and Gujarat. It occupied area of 8.06 mha with production of 11.75 mt and productivity of 1458 kg/ha by the year 2021-22 [2].

Rajasthan state contributed major part of 3.37 m ha with 5.48 mt production and 1627 kg/ha productivity. It is mainly grown in Ganganagar, Hanumangarh, Bharatpur, Tonk, Jaipur, Swaimadhopur, Sikar, Nagaur and Jalore districts of Rajasthan [4]. Pearlmillet- mustard crop sequence is biggest in North-Western India particularly in Rajasthan, Uttar Pradesh, Haryana and Madhya Pradesh and reported high productivity and profitability. This crop sequence is more popular due to low water, inputs and labour in contrast to other pearlmillet based systems [8, 15]. Our soils have been exhausted in respect of major and minor elements encumbering the yield of crops. Appropriate and optimum application of fertilizers not only improve yield but also positively affects on the quality parameters of the crop. Towards restraint this trend of declining yield, there is need to implement the concept of included nitrogen management. The concept of integrated nitrogen management has emerged as a vital tool for sustaining soil fertility, crop productivity which requires optimal use of organic, inorganic and bio-source of plant nutrients [7, 14].

The greatest of inorganic might be found in the presence of satisfactory organic manures and thathighestpearlmillet- mustard crop yield might be found through balancing use of organic or inorganic fertilizers. By way of the application of RDF, yield potential of this crop system has reached to a region for soil health consumes declined and particularly organic matter has depleted. Organic manures also supplies the micro nutrients which is absent in straight fertilizers [8, 7]. The biofertilizers obligate also emerged hopeful modules of integrated nutrient supply arrangement which are environment friendly and low cost inputs. Application of all the recommended nutrients through chemical fertilizers has adversely effect on soil health, leading to lower crop yields. Consequently, there is need to improve nutrient supply system for enhancing production potential of this very imperative crop sequence. Therefore, a study was undertaken to estimate the effect of integrated nitrogen management on protein content in pearlmilletcrop under mustardbased cropping system.

MATERIALS AND METHODS

Field trial was conducted during 2021-22 and 2022-23 at Agronomy Farm of S.K.N. College of Agriculture, Jobner (Rajasthan). The site of this experiment is characterized through Agro-climatic zone IIIa (Semi-Arid Eastern Plain Zone). The typical rainfall of the locality ranges between 400-500 mm, greatest of which is contributed by the South-West rainy season during the months of July - August. The soil was loamy sand in texture having pH rate of 8.4, poor in available N (128 kg ha^{-1}), medium in phosphorus (14 kg ha^{-1}) and available K (148 kg ha^{-1}). The experiment was laid out in Split Plot Design (SPD) with 6 treatments are comprising integrated nitrogen management (control, 100% RDN, 75% RDN + 25% N through FYM, 50% RDN + 50% N through FYM, 25% RDN + 75% N through FYM and 100% N through FYM) and four levels of liquid organic manures (control, panchagvya, vermiwash and cow urine) with three replications. Different treatments were applied during kharif season while mustard variety Giriraj (DRMR IJ-31) in rabi season raised on residual fertility levels (Table 1). The FYM was applied before one month of the crow sowing of pearlmillet crop. Total amounts of phosphorus and potassium and half quantity of nitrogen as per treatment were applied at the time of sowing and rest of nitrogen was top dressed at first irrigation. Urea was used as sources of nitrogen separately. Pearlmillet seed (4 kg ha^{-1}) was used for sowing in first week of July in both the years. Subsequently harvest of pearlmillet, mustard crop was sown in second week of November in the existing layout. Two irrigations were applied in mustard crop as per the recommendation of crop. After the crop harvest, seed , stover were collected to quantify the seed yield potential of mustard. The grain / seed and stover samples were digested by di acid mixture of HNO_3: $HClO_4$ (10: 4 ratio). Phosphorus and K nutrient content was digested with acid extract; determined by vanadomolydo phosphoric yellow color method [20] and flame photometer, respectively [12]. Nitrogen content was determined through modified Kjeldahl method. Protein content (quality) in grain was calculated by multiplying N content in grain (%) with a factor 6.25 [1]. The uptake of nutrients was multiplied since the data on nutrient concentration multiplied through yields of both the crops. The trend of results during both the years were subjected to pooled analysis for data. The least significant difference (lsd) was calculated at 5 percent as per the method described [10].

Table 1. Treatment details and their symbols of pearlmillet-mustard

Treatments	Symbols
(A) Integrated nitrogen management (main plots)	
Control	N_0
100% RDN	N_1
75% RDN + 25% N through FYM	N_2
50% RDN + 50% N through FYM	N_3
25% RDN + 75% N through FYM	N_4
100% N through FYM	N_5
(B) Liquid organic manures (sub plots)	
i. Control	L_0
ii. Panchgavya (foliar spray at vegetative and pre flowering stages)	L_1
iii. Vermiwash (foliar spray at vegetative and pre flowering stages)	L_2
iv. Cow urine (foliar spray at vegetative and pre flowering stages)	L_3

RESULTS AND DISCUSSION

Integrated nitrogen management effect on protein content

The protein content in grain was also better-quality significantly due to altered integrated nitrogen management treatments during together the years of investigation as well as in pooled analysis of pearlmillet crop (Table 2). The maximum value of protein content (12.60%) was recorded under 25% RDN + 75% N through FYM which was closely followed by 50% RDN + 50% N through FYM (12.51%) and 75% RDN + 25% N through FYM (12.26%). Remaining at par among themselves, these 3 treatments enhanced the protein content in pearlmillet grain by 20.6, 19.7 or 17.3 per cent, individually over control. Use of 100% RDN and 100% N through FYM also recorded 9.6 and 8.3 per cent higher protein content than control.

Liquid organic manures effect on protein content

It is also apparent from the pooled data presented in Figure 1 that two foliar sprays of 3% panchagavya at vegetative and pre- flowering stages attained the highest crude protein content in pearlmillet grain (12.53%) indicating an growth of 5.2, 7.7 and 13.9 per cent as comparedto two foliar spray of 10% vermiwash, 10% cow urine and control, respectively. Results further

revealed that foliar spray of vermiwash and cow urine also enhanced the protein content through 8.3 and 5.7 per cent over control, but the difference in protein content observed under these two treatments was not of statistical significance.

Table 2. Effect of integrated nitrogen management and liquid organic manures on protein content of pearlmillet grain

Treatments	Protein content (%)		
	2021	2022	Pooled
Integrated nitrogen management			
N_0 - Control	10.63	10.26	10.45
N_1 - 100% RDN	11.69	11.20	11.45
N_2 - 75% RDN + 25% N through FYM	12.51	12.02	12.26
N_3 - 50% RDN + 50% N through FYM	12.69	12.33	12.51
N_4 - 25% RDN + 75% N through FYM	12.82	12.39	12.60
N_5 - 100% N through FYM	11.57	11.08	11.32
SEm±	0.23	0.24	0.16
lsd (p=0.05)	0.71	0.75	0.49
Liquid organic manures			
L_0 - Control	11.25	10.75	11.00
L_1 - Panchagavya	12.75	12.31	12.53
L_2 - Vermiwash	12.06	11.75	11.91
L_3 - Cow urine	11.88	11.38	11.63
SEm±	0.14	0.14	0.12
lsd (p=0.05)	0.41	0.42	0.35

The quality content in pearlmillet grain was significantly improved over control by different integrated nitrogen management treatments (Table 2). 25% RDN + 75% N through FYM (12.60 %), 50% RDN + 50% N through FYM (12.51%), 75% RDN + 25% N through FYM (12.26%) and 100% RDN (11.45 %) were among the superior treatments wherein marked increase in protein content in comparison to control was noted. However, these treatments were statistically similar and equally effective among themselves. Enhancement of functional efficiencies of different macro and trace elements resulted since the combined treatments of organic and inorganic sources of nutrients produces crop with bigger quality under experiment. Thus increase in protein content may be due to superior availability of all the quality nutrients to pearlmillet plants through together organic and inorganic sources resulting higher protein

production in the seeds. The increased nutrient uptake of nitrogen which in turn enhanced assimilation of amino acids leading to increased synthesis of quality. The quality content in grain improved from 10.1 % at control to 10.6 % with 100% NPK dose. The application of FYM alone and in combination through fertilizers and bio-fertilizers showed significantly helpful in stimulating the percentage of protein in pearlmillet grain. This may be owing to accumulation of [3, 5, 1]. The mustard crop is a N responsive crop, in this experiment showed more protein content [17]. Application of 10 t FYM ha^{-1} alone also improved the quality content in pearlmillet grain over control. Similar results were reported by [9, 14, 19]. This increment in yield may be ascribed to overall improvement in plant growth parameters associated with higher crop yield and quality of crop under residual effect of organic sources. It is in conformity through the results described by [3]. These results support the observations of other researchers [6,10,12,17].

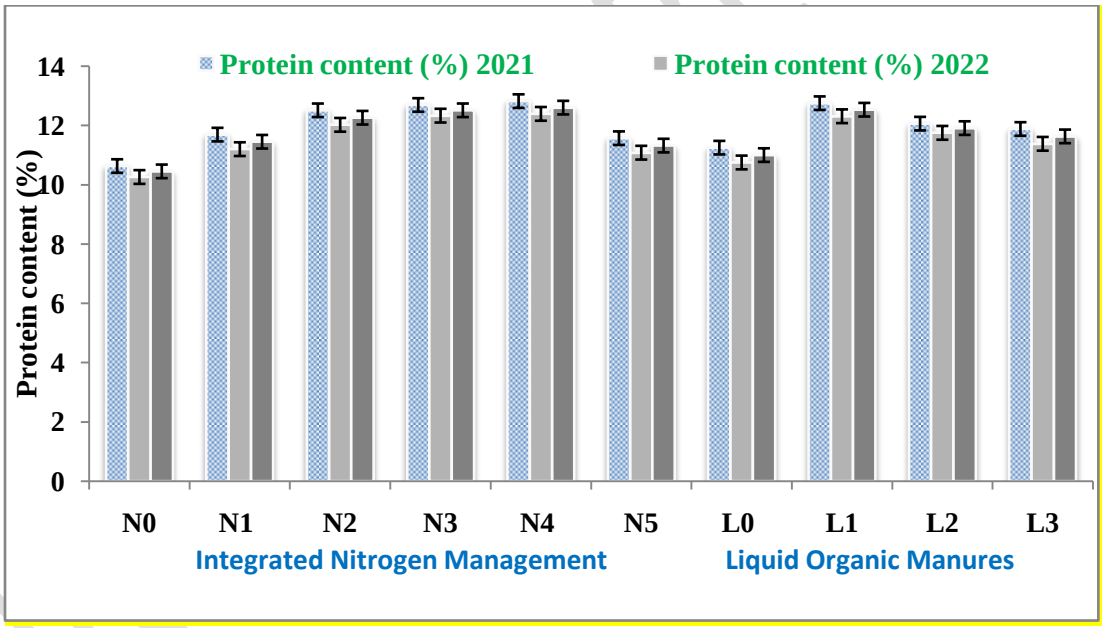

Figure 1. Response of integrated nitrogen management and liquid organic manures on protein content of pearlmillet grain

CONCLUSION

Integrated nitrogen management application improved protein content in pearlmillet crop under pearlmillet-mustard cropping system over control. Application of 25% RDN + 75% N through FYM, 50% RDN + 50% N through FYM and 75% RDN + 25% N through FYM were the most

superior and equally effective treatments in this regard. Being at par among themselves, these treatments also measured significantly higher quality content in pearlmillet grain over control. Such findings are very much useful for improving the pearlmillet protein content in pearlmillet-mustard cropping system by integrated plant nutrient management approach.

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