Original Research Article

Effect of Different Organic and Inorganic Fertility Sources on Protein Content in Pearl Millet Crops Grown in Sandy Soils

ABSTRACT

A field trial conducted at the Agronomy Farm, S.K.N. College of Agriculture, Jobner. The six treatments comprise integrated nitrogen management (control, 100% RDN, 75% RDN + 25% N via FYM, 50% RDN + 50% N to FYM, 25% RDN + 75% N to FYM and 100% N to FYM) and four levels of liquid organic fertilizers (control, panchagvya, vermiwash and cow urine) administered respectively to the main and secondary plots were replicated three times in the split plot design. The pearl millet variety 'RHB 223' was used as a test crop. The results showed that integrated nitrogen management had a useful impact on the yield of the pearl millet crop and then its residual effect on the giriraj mustard variety (DRMR IJ-31). Integrated nitrogen management dramatically increased SOC and improved soil health quality in terms of physical and chemical qualities, in accumulation to a longer crop routine. Among the various treatments, the application of 25% RDN + 75% N through FYM to pearl millet and the application of 50% RDN + 50% N through FYM, its residual effect on the mustard crop increased the quality content and yield of the crop, improved the physico-chemical properties and was reflected as a viable method to improve soil nutrient availability on a sustainable basis.

Keywords - Integrated nitrogen management, Liquid organic fertilisers, Protein content, Pearl millet, Residual effect, Mustard

INTRODUCTION

India is the world's leading producer of pearl millet, occupying 6.70 million hectares (mha), with an average production of 9.62 million tonnes (mt) and a productivity of 1436 kg/ha during 2021-22 [2]. More than 80% of the area below pearl millet is in the arid and semi-arid region of the country. Rajasthan, Uttar Pradesh, Maharashtra, Haryana and Gujarat account

for more than 90% of the total area and production. Rajasthan ranked first in area and production of pearl millet. In India, mustard is predominantly grown in the states of Rajasthan, Uttar Pradesh, Haryana, Madhya Pradesh, and Gujarat. It occupied an area of 8.06 mha with a production of 11.75 mt and a productivity of 1458 kg/ha for the year 2021-22 [2].

The state of Rajasthan contributed most of 3.37 million hectares with a production of 5.48 million tonnes and a productivity of 1627 kg/ha. It is mainly grown in the districts of Ganganagar, Hanumangarh, Bharatpur, Tonk, Jaipur, Swaimadhopur, Sikar , Nagaur and Jalore of Rajasthan [4]. The cultivation sequence of pearl millet and mustard is highest in northwestern India, particularly in Rajasthan, Uttar Pradesh, Haryana and Madhya Pradesh, and reported high productivity and profitability. This cropping sequence is more popular due to the scarcity of water, inputs, and labor, in contrast to other pearl millet-based systems [8, 15]. Our soils have been depleted when it comes to the major and minor elements that hinder crop yields. The proper and optimal application of fertilizers not only improves yields, but also has a positive impact on crop quality parameters. To curb this trend of declining yields, it is necessary to apply the concept of included nitrogen management. The concept of integrated nitrogen management has become a vital tool for maintaining soil fertility, crop productivity, which requires optimal use of organic, inorganic and biological plant nutrients [7, 14].

The greatest of the inorganics could be found in the presence of satisfactory organic fertilizers and thatthe highest yield of pearl millet and mustard crops could be found through the balanced use of organic or inorganic fertilizers. Through the application of RDF, the yield potential of this cropping system has reached a region for soil health, consumptions decreased and, in particular, organic matter was depleted. Organicfertilizer also supplies micronutrients that are absent in pure fertilizers [8, 7]. Biofertilizers also emerged hopeful modules of an integrated agreement for the supply of nutrients that are environmentally friendly and low-cost inputs. Applying all recommended nutrients through chemical fertilizers has an adverse effect on soil health, leading to lower crop yields. Consequently, there is a need to improve the nutrient delivery system to increase the production potential of this highly imperative crop sequence. Therefore, a study was conducted to estimate the effect of

integrated nitrogen management on protein content in pearl millet cultivation under a mustard-based culture system.

MATERIALS AND METHODS

The field trial was conducted during 2021-22 and 2022-23 at the Agronomy Farm of the S.K.N. College of Agriculture, Jobner, Rajasthan. The site of this experiment is characterized throughAgroclimatic Zone IIIa (Eastern Semi-Arid Plain Zone). Typical rainfall in the locality ranges between 400-500 mm, the highest of which is provided by the rainy season in the southwest during the months of July to August. The soil was sandy loam with a texture with a pH 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 proposed in Divided Plot Design (SPD) with 6 treatments that include 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 fertilizers (control, panchagvya, vermiwash and cow urine) with three repetitions. Different treatments were applied during the kharif season, while the Giriraj mustard variety (DRMR IJ-31) in the rabies season was elevated above residual fertility levels (Table 1). The FYM was applied within one month of the planting of crow from the pearl millet crop. At the time of planting, total amounts of phosphorus and potassium were applied and half of nitrogen according to the treatment and the rest of the nitrogen was applied in the first irrigation. Urea was used as separate nitrogen sources. Pearl millet seed (4 kg $^{ha-1}$) was used for planting in the first week of July in both years. Subsequently, the pearl millet crop, the mustard crop was sown in the second week of November in the existing layout. Two irrigations were applied to the mustard crop according to the crop's recommendation. After harvesting the crop, seeds and stubble were collected to quantify the yield potential of mustard seeds. Grain/seed and stubble samples were digested by a diacid mixture of HNO_3:$HClO_4$ (10:4 ratio). Phosphorus and nutrient content K was digested with acid extract; determined by vanadomolydo's phosphoric yellow color method [20] and flame photometer, respectively [12]. The nitrogen content was determined using the modified Kjeldahl method.

The protein content (quality) in grain was calculated by multiplying the N content in grain (%) by a factor of 6.25 [1]. Nutrient uptake multiplied as data on nutrient concentration multiplied across yields of both crops. The evolution of the results during both years was subjected to a pooled data analysis. The least significant difference (LSD) was calculated at 5 percent according to the method described [10].

Table 1. Details of the treatment and its pearl-mustard millet symbols

T reatments	Symbols
A) Integrated nitrogen management (main plots)	
Control	N_0
100% RDN	N_1
75% RDN + 25% N via FYM	N_2
50% RDN + 50% N via FYM	N_3
25% RDN + 75% N via FYM	N_4
100% N to FYM	N_5
(B) Liquid organic fertilisers (sub-plots)	
I. Control	L_0
Ii. Panchgavya (foliar spraying in the vegetative and pre-flowering stages)	L_1
Iii. Vermiwash (foliar spray in the vegetative and pre-flowering stages)	L_2
Iv. Cow urine (foliar spraying in the vegetative and pre-flowering stages)	L_3

RESULTS AND DISCUSSION

Effect of Integrated Nitrogen Management on Protein Content

The protein content in the grain was also of better quality due to the alteration of the integrated nitrogen management treatments during the years of research, as well as in the combined analysis of the pearl milletcrop (Table 2). The maximum value of protein content (12.60%) was recorded below 25% RDN + 75% N to FYM, closely followed by 50% RDN + 50% N to FYM (12.51%) and 75% RDN + 25% N to FYM (12.26 %). Staying on par with each other, these 3 treatments increased the protein content in the pearl millet grain by 20.6, 19.7 or 17.3 percent,

individually over the control. The use of 100% RDN and 100% N via FYM also recorded a protein content 9.6 and 8.3% higher than the control.

Effect of Liquid Organic Fertilizers on Protein Content

From the pooled data presented in Figure 1 it is also clear that two 3% foliar sprays of panchagavya in the vegetative and pre-flowering stages achieved the highest crude protein content in pearl millet grain (12.53%), indicating a growth of 5.2, 7.7 and 13.9 percent compared to two foliar sprays of 10% vermiwash, 10% cow urine and control. respectively. The results further revealed that foliar spraying of vermiwash and cow urine also improved protein content by 8.3 and 5.7 percent over the control, but the difference in protein content observed with these two treatments was not statistically significant.

Table 2. Effect of Integrated Nitrogen Management and Liquid Organic Fertilizers on the Protein Content of Pearl Millet Grain

Treatments	Protein content (%)		
	2021	2022	Combined
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 via 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 via 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 Fertilizers			
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 pearl millet grain was significantly improved with respect to control with different integrated nitrogen management treatments (Table 2). 25% RDN + 75% N via FYM (12.60%), 50% RDN + 50% N via FYM (12.51%), 75% RDN + 25% N to FYM (12.26%), and 100% RDN (11.45 %) are among the top treatments in which marked Increase in protein content compared to control. However, these treatments were statistically similar and equally effective with each other. Improving the functional efficiencies of different macro and trace elements resulted in combined treatments of organic and inorganic sources of nutrients producing higher quality crops under experimentation. Therefore, the increase in protein content may be due to superior availability of all quality nutrients for pearl millet plants through organic and inorganic sources together, resulting in increased protein production in the seeds. Increased nutrient uptake from nitrogen, which in turn improved amino acid assimilation, leading to higher quality synthesis. Grain quality content improved from 10.1% at control to 10.6% at 100% NPK dose. The application of FYM alone and in combination through fertilizers and biofertilizers showed significant help in stimulating the percentage of protein in pearl millet grain. This may be due to the accumulation of [3, 5, 1]. The mustard culture is an N-sensitive culture, in this experiment it showed more protein content [17]. The application of 10 t FYM $^{ha\text{-}1}$ alone also improved the quality content in the pearl millet grain over control. Similar results were reported by [9, 14, 19]. This increase in yield can be attributed to the overall improvement in plant growth parameters associated with higher crop yield and quality under the residual effect of organic sources. It is in accordance with the results described in [3]. These results support the observations of other researchers [6,10,12,17].

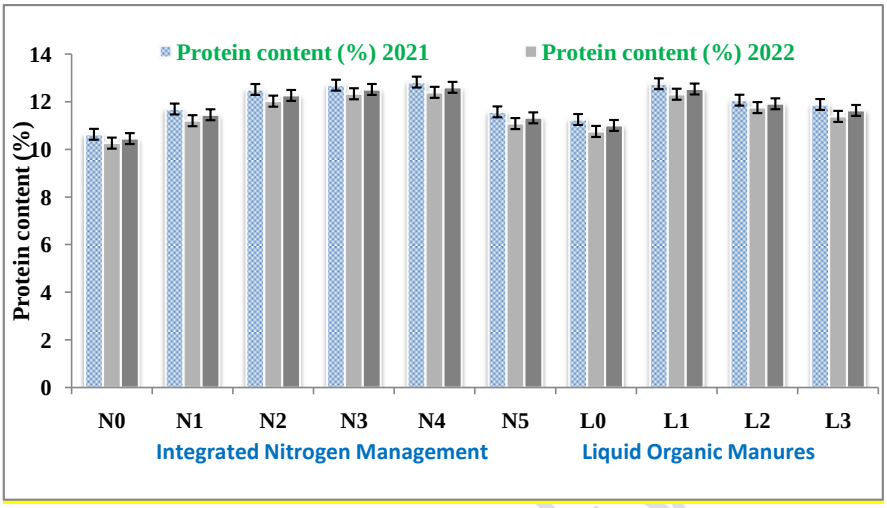

Figure 1. Integrated management of nitrogen and liquid organic fertilizers on the protein content of pearl millet grain

CONCLUSION

The application of integrated nitrogen management improved the protein content in the pearl millet crop under the pearl millet and mustard culture system over the control. The 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 on par with each other, these treatments also measured significantly higher quality content in the pearl millet grain than in the control. These findings are very useful for improving the protein content of pearl millet in the pearl millet and mustard cropping system using an integrated plant nutrient management approach.

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