Available online at www.ijpab.com

DOI: http://dx.doi.org/10.18782/2582-2845.8710

ISSN: 2582 – 2845

Ind. J. Pure App. Biosci. (2021) *9*(3), 174-179

Indian Journal of Pure & Applied Biosciences

Peer-Reviewed, Refereed, Open Access Journal

Research Article

Effect of Intercropping and Fertility Levels on the Nitrogen, Phosphorus and Potash Content and Uptake by Summer Pearlmillet (*Pennisetum glaucum* L.) under South Gujarat Condition

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Received: 7.05.2021 | Revised: 11.06.2021 | Accepted: 18.06.2021

ABSTRACT

A field experiment was conducted at College Agronomy Farm, N. M. College of Agriculture, Navsari Agricultural University, Navsari during summer, 2019 and 2020 comprising four intercropping treatments i.e. pearlmillet sole, pearlmillet+greengram, pearlmillet+cowpea, pearlmillet+clusterbean and three fertility levels viz., 75 % RDF, 100 % RDF and 125 % RDF. Among the different intercropping system examined, sole pearl millet (I_1) accumulated significantly less content of N and P in pearl millet grain and straw as compared to intercropping with pulses treatments. Pearl millet + green gram (I_2) recorded significantly higher N and P uptake by pearl millet straw than other intercropping systems. The sole pearl millet (I_1) was at par with pearl millet intercropped with green gram (I_2) had significantly higher K content and uptake in pearl millet grain and straw. In case of fertility levels, nitrogen and phosphorus content and uptake in pearl millet grain and straw were recorded significantly higher by application of 100 % RDF. Significantly higher N, P and K uptake by pearl millet grain and straw in pooled results were produced by treatment combination of pearl millet + green gram (I_2) intercropping along with 75 % RDF (F_1).

Keywords: *Pearlmillet, RDF.*

INTRODUCTION

Pearlmillet, locally called as *bajra* is an important dual purpose crop as its grain is used for human consumption and its fodder as cattle feed. It ranks fourth after rice, wheat and sorghum and is grown in almost all the states of the country. Limited availability of land resources and the decline in the soil fertility has increased the importance of the ability of agriculture to sustain the increasing demand of the population both globally and locally.

Cite this article: Patel, K. R., Thanki, J. D., & Lunagariya, D. D. (2021). Effect of Intercropping and Fertility Levels on the Nitrogen, Phosphorus and Potash Content and Uptake by Summer Pearlmillet (*Pennisetum glaucum* L.) under South Gujarat Condition, *Ind. J. Pure App. Biosci. 9*(3), 174-179. doi: http://dx.doi.org/10.18782/2582-2845.8710

To counter the demand, we have to look for ways which enhance the use of currently available resources than in the past. Intercropping is one promising practise which is effective to augment the total productivity per unit area of the land per unit time by growing more than one crop in the same field with an objective of better utilization of environmental resources. The basic concept of intercropping involves growing together two or more crops with the assumption that two crops can exploit the environment better than one and ultimately produce higher yield (Reddy & Willy, 1981). Cereal- pulses intercropping has attracted the attention of agronomists, possibly as a result of the established and theoretical advantages of intercropping systems (Ofori & Stern, 1978). Intercropping with pulses is a practice in which N fixed by latter enhances the qualitative and quantitative traits of the former to finally reach food security and sustainability (Swaminathan, 1998). Pulses such as cowpea, clusterbean and greengram are known to fix the atmospheric nitrogen with the help of rhizobium bacteria and it supplies the cereal crop with the required nitrogen. Fertilizer management is one of the important cost effective factors known to augment the crop production. Hence, inclusion of pulses in any intercropping system has becomes imperative with the overall view of maintaining soil fertility and for economizing fertilizer use.

Experimental materials and methods

The field experiment was conducted during summer season of both the years 2019 and 2020 at N. M. College of Agriculture, Navsari Agricultural University, Navsari. The soil of the experimental field was clayey in texture, low in organic carbon content (0.41 %) and available nitrogen (199.86 kg/ha), medium in available phosphorus (39.43 kg/ha) and fairly high in available potassium (302.88 kg/ha). The soil was slightly alkaline in reaction (pH 7.9). The experiment was laid out in factorial randomized block design with 12 combinations comprising of four intercropping treatments (pearlmillet sole, pearlmillet + greengram, pearlmillet + cowpea and pearlmillet + clusterbean) and three fertility levels (75%, 100% and 125% of RDF) replicated three times. The pearlmillet variety GHB-558, greengram variety GM-6, cowpea variety GC-5 and clusterbean Gujarat Guar - 1were used as a test varieties. Pearl millet was sown in paired rows at 30 cm keeping 60 cm distance between 2 pairs to adjust 1 row of intercrop. Fertilizer application was done on area basis as per treatment to only pearlmillet crops (RDF is 120-60-00 kg NPK/ha for pearlmillet). Plant samples of grain and straw of pearlmillet collected at harvest were grind in willey mill to pass through 40 mesh sieve. The grounded material was collected in butter paper bags and later used for chemical analysis. Nitrogen, phosphorus and potassium content from grain and straw were estimated using standard procedures given by Jackson (1963). Uptake of nutrients by grain and straw was calculated by using following formula:

$$\text{Nutrient uptake (kg/ha)} = \frac{\text{Nutrient content (\%) x yield (kg/ha)}}{100}$$

Analysis of variance for factorial randomized block design and significance of variance was tested by F-test (Gomez & Gomez, 1984). Critical difference for examining treatmental means for their significance was calculated at 5% significance.

RESULTS AND DISCUSSION

Effect of intercropping

Nitrogen content and uptake by grain and straw were observed significantly higher in I_2 (pearlmillet + greengram), it was at par with I_3 (pearlmillet + cowpea) in pooled analysis. The reason for improvement in nutrient content of pearlmillet grown with pulses may be attributed to ‘‘mutual avoidance’’ which implies that the roots tend to avoid the areas that have already been depleted of resources by an associated crop. Pearlmillet and pulses differed in growth habits and duration. Thus the component crops have their peak demands

for nutrients at different stages of growth; a temporal effect may ensure that the demand does not overlap. Above all, the more obvious cause of complementarily may have arisen from differences among component crops in their nutrient requirements. The findings are in accordance with Keshwa and Kumar (2012), Gaina et al. (2014) and Desai et al. (2014). Pearlmillet grain phosphorus content was significantly higher in pearlmillet + greengram (I_2) intercropping system which was at par with pearlmillet + cowpea (I_3). The findings are in close agreement with those obtained by Keshwa and Kumar (2012), Gaina et al. (2014) and Desai et al. (2014). Sole pearlmillet crop (I_1) registered significantly higher potassium uptake by pearlmillet grain and straw during individual years and pooled analysis which was at par with pearlmillet + greengram (I_2) intercropping system. These findings are in close conformity with those obtained by Kujur et al. (2010) and Hooda et al. (2015).

Effect of fertility levels

Crop fertilized with 125 % RDF (F_3) recorded significantly higher values of Nitrogen, phosphorus and Potassium content and uptake in grain and straw during both the years and pooled data but it was found at par with pearlmillet crop fertilized with 100 % RDF (F_2). The increase in Nitrogen concentration might be outcome of the increased availability of Nitrogen to plant. These results are in confirmation with Vari and Sadhu (2013), Gaina et al. (2014) and Kumar et al. (2014).

Interaction effect

The interaction between intercropping system and different fertility levels to pearlmillet was found non-significant for Nitrogen, phosphorus and Potassium content in pearlmillet grain and straw during individual years and pooled analysis. But in case of Nitrogen, phosphorus and Potassium uptake by grain and straw was found significant in pooled analysis.

Table 1: Effect of intercropping and fertility levels on N, P and K content in grain and straw of pearlmillet (Pooled data of two year)

Treatment	N content (%)		P content (%)		K content (%)	
	Grain	Straw	Grain	Straw	Grain	Straw
A. Intercropping						
I_1: sole crop pearl millet	1.72	0.36	0.25	0.11	0.70	0.91
I_2: pearl millet + green gram	2.06	0.41	0.31	0.12	0.69	0.89
I_3: pearl millet + cowpea	1.97	0.39	0.29	0.11	0.65	0.86
I_4: pearl millet + cluster bean	1.81	0.37	0.24	0.11	0.63	0.86
SEm ±	0.04	0.01	0.005	0.002	0.01	0.01
CD (P=0.05)	0.12	0.02	0.02	NS	0.02	0.04
B. Fertilitylevels						
F_1: 75 % RDF	1.77	0.32	0.26	0.11	0.63	0.84
F_2: 100 % RDF	1.92	0.40	0.27	0.11	0.68	0.90
F_3: 125% RDF	1.98	0.42	0.28	0.12	0.70	0.90
SEm ±	0.04	0.01	0.004	0.002	0.01	0.01
CD (P=0.05)	0.11	0.02	0.01	0.01	0.03	0.03
Interaction effect (I × F)						
SEm ±	0.09	0.01	0.009	0.003	0.02	0.02
CD (P=0.05)	NS	NS	NS	NS	NS	NS
Sig. interactions with Y	NS	NS	NS	NS	NS	NS
CV (%)	9.82	8.30	7.93	7.24	7.80	6.39

Table 2: Effect of intercropping and fertility levels on N, P and K uptake in grain and straw of pearlmillet (Pooled data of two year)

Treatment	N uptake (kg/ha)		P uptake (kg/ha)		K uptake (kg/ha)	
	Grain	Straw	Grain	Straw	Grain	Straw
A. Intercropping						
I_1: sole crop pearl millet	51.69	19.70	7.41	5.89	20.95	49.08
I_2: pearl millet + green gram	61.45	21.92	9.13	6.15	20.42	47.60
I_3: pearl millet + cowpea	48.90	18.39	7.09	5.32	16.13	41.06
I_4: pearl millet + cluster bean	41.27	15.01	5.56	4.53	14.35	35.23
SEm ±	1.47	0.52	0.20	0.14	0.46	1.02
CD (P=0.05)	4.19	1.48	0.56	0.41	1.30	2.89
B. Fertilitylevels						
F_1: 75 % RDF	45.33	15.00	6.67	4.99	16.13	39.56
F_2: 100 % RDF	52.73	19.58	7.37	5.55	18.58	44.24
F_3: 125% RDF	54.42	21.68	7.85	5.87	19.18	45.93
SEm ±	1.27	0.45	0.17	0.12	0.40	0.88
CD (P=0.05)	3.63	1.28	0.49	0.35	1.13	2.51
Interaction effect (I × F)						
SEm ±	2.55	0.90	0.34	0.25	0.79	1.76
CD (P=0.05)	7.26	2.57	0.98	0.70	2.26	5.01
Sig. interactions with Y	NS	NS	NS	NS	NS	NS
CV (%)	12.27	11.77	11.50	11.04	10.80	9.96

Table 3: Nitrogen, Phosphorus and Potassium uptake by pearlmillet grain as influenced by interaction of different treatments (Pooled data of two year)

	Nitrogen uptake by grain (kg/ha)		
Intercropping (I)			
	Fertility levels (F)		
	F_1	**F_2**	**F_3**
I_1	49.63	50.86	54.57
I_2	53.42	59.28	71.66
I_3	42.82	58.38	45.51
I_4	35.46	42.41	45.94
CD (P=0.05)	7.25		
	Phosphorus uptake by grain (kg/ha)		
	F_1	**F_2**	**F_3**
I_1	7.00	7.37	7.87
I_2	8.28	8.36	10.75
I_3	6.53	7.97	6.78
I_4	4.88	5.80	6.01
CD (P=0.05)	0.97		
	Potassium uptake by grain (kg/ha)		
	F_1	**F_2**	**F_3**
I_1	19.66	20.47	22.72
I_2	18.84	20.15	22.26
I_3	14.39	18.30	15.71
I_4	11.62	15.40	16.04
CD (P=0.05)	2.25		

Table 4: Nitrogen, Phosphorus and Potassium uptake by pearlmillet straw as influenced by interaction of different treatments (Pooled data of two year)

	Nitrogen uptake by straw (kg/ha)		
Intercropping (I)			
	Fertility levels (F)		
	F_1	**F_2**	**F_3**
I_1	15.38	20.34	23.37
I_2	18.04	22.08	25.64
I_3	14.41	17.10	23.65
I_4	12.16	18.81	14.05
CD (P=0.05)	2.56		
	Phosphorus uptake by straw (kg/ha)		
	F_1	**F_2**	**F_3**
I_1	5.35	5.87	6.44
I_2	5.65	6.06	6.75
I_3	4.93	4.73	6.29
I_4	4.02	5.55	4.02
CD (P=0.05)	0.70		
	Potassium uptake by straw (kg/ha)		
	F_1	**F_2**	**F_3**
I_1	45.90	49.61	51.71
I_2	44.81	47.88	50.12
I_3	37.86	43.18	49.05
I_4	29.66	36.27	32.83
CD (P=0.05)	5.01		

CONCLUSION

The results of present experiment could be concluded that the cultivation of pearlmillet + green gram in intercropping of field with 75 % RDF increased nutrient content and uptake by pearlmillet grain and straw improved soil properties as well as farmers economy grown under summer condition of south Gujarat.

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