J. Soils and Crops 33 (1) 221-226, June 2023

ISSN 0971-2836 (Print)
ISSN 2582-2756 (Online)

EEFECT OF LAND CONFIGURATION AND NUTRIENT MANAGEMENT PRACTICES ON SOIL FERTILITY STATUS, QUALITY AND UPTAKE OF NUTRIENTS BY MAIZE

R.M.Ghodpage[1], Padmaja H.Kausadikar[2], A. R. Mhaske[3], A. R.Pimple[4] and Nikhil Sarnaik[5]

ABSTRACT

The field investigation was carried out during *kharif* season for the year 2017-18 at EAD Farm ,College of Agriculture, Nagpur with an objective to study the effect of different mechanical measures in-combination with nutrients management practices on soil fertility, nutrient uptake and quality of maize. Results revealed that, the total uptake of N and P nutrient by maize was increased by 29.63 and 19.66 per cent with the treatment combination of 125% RDF with ridges and furrows + *in situ* green sunhemp over 75% RDF with flat bed + *in situ* green sunhemp , respectively. Availability of nitrogen content in soil increased by 9.66 to 14.52 per cent with the practice of balanced nutrients management as compared to lower dose of major nutrient. Whereas availability of phosphorus content increased in soil to the tune of 12.45 to 30.09 per cent under balanced nutrient management practices over to 75% RDF with flat bed + *in situ* green sunhemp . Grain yield of maize was increased with the treatment combination of 125% RDF with ridges and furrows + *in situ* green sunhemp by 8.01 and 19.68 per cent over the 100 % RDF with flat bed (51.88 q ha^{-1}) and 75% RDF with flat bed + *in situ* green sunhemp (45.30 q ha^{-1}), respectively.Among the interaction effect of quality parameters, highest protein 10.89 per cent was observed with the application of 125% RDF combined with ridges and furrow + green in situ of sunhemp. Ca and Mg content in maize grain were observed highest by 0.417 and 0.257 per cent, respectively with higher dose of NPK under ridges and furrow + in situ green sunhemp method.

(Key words: *In situ* green sunhemp, land configuration, quality, maize)

INTRODUCTION

A mechanical measure is a beneficial technology for *in situ* moisture conservation in the area of erratic behavior of rainfall and also helps in drainage under heavy rainfall. Practice of making ridges by opening furrow may have an advantage in conservation of more rain water on the bed which enriches soil moisture content (Karunadevi *et al*., 2007).The mechanical measures not only improve soil drainage but also leads to efficient use of limited water for profitable crop production. For uniform distribution of rain water, broad bed furrow, ridges and furrow and flat-bed may be required. Maize is one of the important cereals cultivated with traditional package of practices and with inadequate levels of inputs. Maize productivity is low in India as compared to other maize growing countries. This is due to the fact that, it is largely cultivated under rainfed condition on marginal and sub-marginal land mostly by poor farmers without giving much emphasis on important agronomic practices of proper sowing method, inter-cultivation and nutrient management and mechanical measures.Various factors of production deciding the maize productivity under rainfed condition are nutrients management practices, mechanical measures/land configuration and plant density. Out of these factors, mechanical measures and nutrients management have significance in stepping up the yield of maize during the *kharif* season. Maize crop has better yield response to chemical or inorganic fertilizers. Hence, heavy doses of fertilizers are applied to maize through nutrient management practices and proper mechanical measures can helps to increase the production of crop.

MATERIALS AND METHODS

Considering the various management practices adopted by farmers for rainfed maize , the nutrients management and mechanical measures in vertisol were selected during the year 2017-2018 to study the fertility status of soil, uptake of nutrients and quality of maize under different mechanical measures in-combination with various nutrients management. Three treatments of mechanical measures i.e. ridges and furrow + *in-situ* green sunhemp, broad bed furrow + *in-situ* green sunhemp and flat bed +

1. Professor (CAS), SSAC Section, College of Agriculture, Nagpur
2. Asstt. Professor, SSAC Section, College of Agriculture, Nagpur
3. Professor (CAS), Agri. Engineering, College of Agriculture, Nagpur
4. Asstt. Professor, Agri. Engineering, College of Agriculture, Nagpur
5. P.G. Student, SSAC Section, College of Agriculture, Nagpur

in-situ green sunhemp and four nutrients management i.e.0% RDF (00:00:00 kg NPK ha^{-1}), 75% RDF (90:45:45 kg NPK ha^{-1}), 100% RDF (120:60:60 kg NPK ha^{-1}) and 125% RDF (150:75:75 kg NPK ha^{-1}) were studies in Factorial Randomized Block Design, replicated thrice. The soil of experimental plot was clayey in texture, slightly alkaline in reaction, low in available nitrogen and phosphorus, medium in organic carbon, very high in available potassium. The maize variety PKVM Shatak, was sown on 5th July, 2017 by dibbling the seed in rows, marked at a spacing of 60 cm x 20 cm. Open the furrow after one of sowing and cut the sunhemp from bottom and spread it. Half dose of nitrogen through urea was applied at sowing and remaining at 30 days after sowing. Full dose of phosphorus and potash was given at the time of sowing to all the plots through single super phosphate and muriate of potash, respectively. Available nitrogen was analysed using Kjeldahl's method (Subbiah and Asija, 1956), Phosphorus estimated by using Olsen's method (Jackson, 1973) and potassium was estimated from 1N ammonium acetate extract using flame photometer (Jackson,1973). Protein per cent in seed of maize was worked out by multiplying nitrogen content of seed with factor 6.25.Calcium and magnesium content in grain extract was determined by EDTA method (Jackson,1973).

RESULTS AND DISCUSSION

Fertility status of soil

The results pertaining to fertility status of soil after harvest of crop are presented in Table 1. Available nitrogen of soil was observed between 207.76 to 221.72 kg ha^{-1} with the methods of different mechanical measures but it was found statistically non significant. However, available nitrogen in soil was found significant with the application of different fertilizer management practices. The maximum available nitrogen (232.5 kg ha^{-1}) was obtained with the combination of 150:75:75 kg ha^{-1}+ method of ridges and furrow + green *in situ* of sunhemp. Availability of nitrogen content was increased in soil by 9.66 to 14.52 per cent under management practice of balanced nutrients management as compared to lower dose of major nutrient.Gable *et al*. (2008) reported that application of 100 per cent RDF recorded higher available phosphorus (33.25 kg ha^{-1}) in soil, which was closely followed by 75 per cent RDF + 25 per cent leucaena lopping + Azotobacter (33.10 kg ha^{-1}) under maize-chickpea cropping system. Shah and Wani (2017) reported that the highest soil fertility in terms of available N, P and K was observed when vermicompost 5.5 t ha^{-1} or FYM 5.5 t ha^{-1} was applied in maize and it was at par with the available NPK status of all other treatment combinations except control.

Interaction effect of different mechanical methods and fertilizer application found significant. Maximum available phosphorus (22.23 kg ha^{-1}) was obtained with the combination of 150:75:75 kg ha^{-1}+ method of ridges and furrow + green *in situ* of sunhemp and exhibited increase in availability of fertility status of soil due to application of balanced amount of nutrients and its management practice. Increase the availability of phosphorus content in soil was noticed to the tune of 12.45 to 30.09 per cent under management practice of balanced nutrient management over to lower dose of application of major nutrients. Available potassium of soil was found significant under different fertilizer management practices. The maximum available potassium in soil was observed (570.88 kg ha^{-1}) with the application of 125% RDF (150:75:75 kg NPK ha^{-1}) which was found at par with the application of 120:60:60 kg NPK ha^{-1}. The value of available potassium was very high in range. Interaction effect of different mechanical methods and fertilizer application found significant. Among the different treatment combinations, significantly increase in available phosphorus (22.23 kg ha^{-1}) was observed with the higher dose of 150:75:75 kg ha^{-1}+ method of ridges and furrow + green *in situ* of sunhemp.

Uptake of nutrients (kg ha^{-1}) by maize

The nutrient uptake is a function of yield and nutrient concentration in plant. Maximum total uptake of N (117.24 kg ha^{-1}) was observed under ridge and furrow + green *in situ* of sunhemp method, while highest total uptake of N (146.38 kg ha^{-1}) was observed with the application of 125% RDF (150:75:75 kg NPK ha^{-1}).Interaction effect found significant with respect to total uptake of nutrients (Table 2). The highest total uptake of N (154.03 kg ha^{-1}) was obtained under high dose in combination with RF+ green *in situ* of sunhemp and it was found at par with high dose with BBF+ green *in situ* of sunhemp or flat bed or 100% RDF with RF + green *in situ* of sunhemp. Total uptake of N was maximum by 20.82% under higher doses among RF over 75% RDF, where as it reflected highest to an extent by 29.63% under 125% RDF combined with RF+ green *in situ* of sunhemp over 75% RDF with flat bed + green *in situ* of sunhemp. The increase in nutrient uptake might be due to the availability of nutrients in the soil and application of inorganic fertilizers and also its proper management practices with mechanical measures. Manwar and Mankar (2015) reported increase in maize yield might be due to better drainage condition leading to ideal soil-air-moisture relationship of bed which subsequently reflected increase in various yield attributes like number of cobs $plant^{-1}$, number of grain cob^{-1}, test weight, grain weight cob^{-1} and grain yield $plant^{-1}$. Ram *et al*.(2022) revealed that application of N @ 180 kg ha^{-1} in three splits and entire dose of P (60 kg ha^{-1}) and K (30 kg ha^{-1}) recorded significantly higher growth parameters and yield attributes and nutrient uptake of hybrid maize.

The results revealed that, the total uptake of phosphorus was significantly increased with the increasing level of major nutrients and different methods of land configuration. The maximum total uptake of P (39.13 kg ha^{-1}) was obtained with ridge and furrow + green in situ of sunhemp method, while highest total uptake of P (48.21 kg ha^{-1}) was observed under the application of 125% RDF (150:75:75 kg NPK ha^{-1}). Increase in uptake of phosphorus

has attributed to increase the availability of P in soil due to mineralization, fixation effect and releasing nutrients in to available form. The total uptake of P was increased to the tune of 11.60 to 19.66 per cent with 100% RDF to 125% RDF over the fertilizers applied @ 75% RDF (90:45:45 kg ha^{-1}). Interactive effect of nutrients and different mechanical measures was found significant. Maximum total uptake of K (124.53 kg ha^{-1}) was observed under ridge and furrow + green *in situ* of sunhemp method, while total uptake of K (155.77 kg ha^{-1}) was recorded with the application of 125% RDF (150:75:75 kg NPK ha^{-1}). Higher dose of 150:75:75 kg ha^{-1}+ ridges and furrow + green *in situ* of sunhemp significantly increased the total uptake of K (164.19 kg ha^{-1}) when compared other combination treatments.It clearly shows that application of balanced fertilization resulted in significantly higher uptake by grain and fodder in maize. The increase in potassium uptake in grain and fodder is ascribed to uptake by increasing root growth, altering plant metabolism and increasing nutrient solubility and its availability.

Quality of maize grain

The results of quality parameters of maize grain *viz.,* protein, calcium and magnesium per cent are depicted in Table 3. Results revealed that protein content in maize varied from 9.68 to 10.82 with no use of fertilizer to maximum application of 125% RDF (150:75:75 kg NPK ha^{-1}). Maximum protein (10.82%) was recorded with the application of 125% RDF. It could be ascribed to direct effect on nitrogen content in seed. Interaction effect on protein content exhibited significant. The highest protein content (10.89%) was observed under 125% RDF combined with method of ridges and furrow + green *in situ* of sunhemp but it was found at par with 100% RDF (120:60:60 kg NPK ha^{-1}) with all different mechanical measures. Kumavat *et al.* (2016) reported highest protein content (10.43%) under 120% RDF but was remained at par with 100% dose (120:60 kg NP ha^{-1}) to maize.

Calcium is an important to N metabolism and protein formation by enhancing NO_3^-uptake, translocation of carbohydrate and nutrients. It provides some regulations of cation uptake. Concentration of calcium in maize grain found significant with various fertilizer management practices. It varied from 0.371 to 0.417 per cent with chemical fertilizers under different methods of land configuration. Calcium content (0.417%) in maize grain was observed highest with higher dose of NPK under ridges and furrow + green *in situ* of sunhemp method but statistically at par with the application of 100% RDF in combination with various methods of land configuration. Increase in Ca content partly due to the addition of SSP which contains 21 per cent calcium. Mg in maize grain was increased significantly under different doses of NPK but it reflected non significant among various mechanical measures. Interaction effect found non significant with respect to magnesium content of maize. However, the maximum magnesium content in maize grain (0.257 per cent) was observed under 150:75:75 kg NPK ha^{-1}in combination with RF + green *in situ* of sunhemp.

Yield of maize

The data pertaining to grain yield of maize as influenced by various treatments are presented in Table 4. The grain yield of maize (44.79 q ha^{-1}) was significantly increased among mechanical measure of ridges and furrow + *in situ* green sunhemp which was found at par with BBF+ *in situ* green sunhemp. Ridges and furrow + *in situ* green sunhemp treatment significantly increased grain yield of maize to the tune of 6.52 over flat bed + *in situ* green sunhemp method indicating more amount of soil moisture conserved due to opening of furrow resulted an increased growth stand and finally might have exhibited slight enhancement in yield. Rajashekarappa *et al.* (2014) reported 15.54 % improvement in the grain yield of maize with moisture conservation practices as compared to control.

Among nutrients management practices, the application of 150:75:75kg NPK ha^{-1}recorded significantly more grain yield of maize (54.10 q ha^{-1}) over the rest of treatments. An increase in grain yield of maize was 63.10, 61.82 and 57.95 per cent due to application of 150:75:75, 120:60:60 and 90:45:45 kg NPK ha^{-1}, respectively over no use of major nutrients. This might be due to adequate availability of nutrients particularly N and P. The highest grain yield of maize (56.40 q ha^{-1}) was obtained in treatment combination of higher dose of 150:75:75 kg NPK $ha^{-1}$and ridge and furrow +*in situ* green sunhemp and it was found on par with higher dose of NPK + BBF + *in situ* green sunhemp. Manwar and Mankar (2015) reported 7.66% and 5.11% increase in yield of maize with methods of ridges and furrow and broad bed furrow, respectively over flat-bed method.

Table 1. Effect of integrated nutrient management and mechanical measure on soil fertility status after harvest of crop

Treatments	Available nutrients		
	N (kg ha^{-1})	P (kg ha^{-1})	K (kg ha^{-1})
A- Mechanical Measures			
1. Ridges and furrows + green *in situ* of sunhemp	221.72	18.82	566.20
2. Broad bed furrows + green *in situ* of sunhemp	211.45	18.62	557.00
3. Flat bed + green *in situ* of sunhemp	207.76	18.25	551.30
SE (m) ±	4.31	0.57	4.39
CD at 5%	-	-	-
B- Nutrients Management			
1. 00:00:00 kg NPK ha^{-1}	201.53	15.71	542.04
2. 90:45:45 kg NPK ha^{-1}	213.24	18.34	554.33
3. 120:60:60 kg NPK ha^{-1}	217.13	19.21	565.26
4. 150:75:75 kg NPK ha^{-1}	222.67	20.98	570.88
SE (m) ±	4.98	0.66	5.07
CD at 5%	14.59	1.92	14.89

Interaction

Nutrients Management	**Mechanical measures**								
	RF+GS	BBF+GS	FB+GS	RF+GS	BBF+GS	FB+GS	RF+GS	BBF+GS	FB+GS
00:00:00 kg NPKha^{-1}	205.02	198.73	200.86	15.95	15.66	15.54	544.46	543.66	538.00
90:45:45 kg NPK ha^{-1}	220.00	213.86	205.86	17.75	19.03	18.23	563.33	550.66	549.00
120:60:60 kg NPK ha^{-1}	229.34	215.69	206.34	19.32	19.24	19.06	575.00	562.46	558.33
150:75:75 kg NPK ha^{-1}	232.50	217.50	218.00	22.23	20.52	20.16	588.00	571.00	559.66
SE (m) ±	8.62				1.13			8.79	
CD at 5%	25.28				3.32			25.79	

GS = Green *in situ* of sunhemp

Table 2. Effect of integrated nutrient management and mechanical measure on total uptake of nutrients after harvest of crop

Treatments	Total uptake, (kg ha^{-1})		
	N	P	K
A- Mechanical Measures			
1. Ridges and furrows + green *in situ* of sunhemp	117.24	39.13	124.53
2. Broad bed furrows + green *in situ* of sunhemp	111.88	37.34	120.43
3. Flat bed + green *in situ* of sunhemp	106.00	35.35	113.03
SE (m) ±	1.16	0.49	1.31
CD at 5%	3.40	1.44	3.85
B- Nutrients Management			
1. 00:00:00 kg NPK ha^{-1}	49.45	16.85	56.33
2. 90:45:45 kg NPK ha^{-1}	116.21	39.44	123.13
3. 120:60:60 kg NPK ha^{-1}	134.78	44.60	142.08
4. 150:75:75 kg NPK ha^{-1}	146.38	48.21	155.77
SE (m) ±	1.34	0.57	1.51
CD at 5%	3.92	1.66	4.44

Interaction

Nutrients Management	**Mechanical measures**								
	RF+GS	BBF+GS	FB+GS	RF+GS	BBF+GS	FB+GS	RF+GS	BBF+GS	FB+GS
00:00:00 kg NPKha^{-1}	53.03	50.68	44.62	18.14	17.16	15.22	60.02	57.73	51.23
90:45:45 kg NPK ha^{-1}	122.43	117.39	108.80	40.93	39.92	37.47	127.96	124.16	117.26
120:60:60 kg NPK ha^{-1}	138.84	133.93	131.56	46.06	44.67	43.05	145.93	144.16	136.13
150:75:75 kg NPK ha^{-1}	154.63	145.48	139.02	51.37	47.60	45.64	164.19	155.64	147.46
SE (m) ±	2.31				0.98			2.72	
CD at 5%	6.88				2.91			-	

GS = Green *in situ* of sunhemp

Table 3. Effect of integrated nutrient management and mechanical measure on quality parameters of maize after harvest of crop

Treatments	Quality parameters		
	Protein %	Ca %	Mg %
A- Mechanical Measures			
1. Ridges and furrows + green *in situ* of sunhemp	10.42	0.401	0.244
2. Broad bed furrows + green *in situ* of sunhemp	10.30	0.394	0.239
3. Flat bed + green *in situ* of sunhemp	10.23	0.391	0.232
SE (m) ±	0.052	0.0039	0.0051
CD at 5%	—	—	—
B- Nutrients Management			
1. 00:00:00 kg NPK ha^{-1}	9.68	0.372	0.222
2. 90:45:45 kg NPK ha^{-1}	10.12	0.393	0.236
3. 120:60:60 kg NPK ha^{-1}	10.66	0.402	0.246
4. 150:75:75 kg NPK ha^{-1}	10.82	0.413	0.255
SE (m) ±	0.060	0.0045	0.0059
CD at 5%	0.17	0.013	0.017

Interaction

Nutrients Management	**Mechanical measures**								
	RF+GS	BBF+GS	FB+GS	RF+GS	BBF+GS	FB+GS	RF+GS	BBF+GS	FB+GS
00:00:00 kg NPKha^{-1}	9.72	9.64	9.66	0.376	0.373	0.371	0.221	0.218	0.211
90:45:45 kg NPK ha^{-1}	10.37	10.12	9.85	0.399	0.392	0.388	0.247	0.248	0.213
120:60:60 kg NPK ha^{-1}	10.68	10.62	10.64	0.413	0.400	0.393	0.253	0.236	0.250
150:75:75 kg NPK ha^{-1}	10.89	10.82	10.74	0.417	0.413	0.411	0.257	0.256	0.253
SE (m) ±		0.105			0.0079		0.010		
CD at 5%		0.30			0.024		—		

GS = Green *in situ* of sunhemp

Table 4. Effect of nutrients management and mechanical measures on grain and fodder yield of maize (q ha^{-1})

Treatments	Grain yield (q ha^{-1})	Fodder yield (q ha^{-1})
A– Mechanical Measures		
1. Ridges and furrows + *in situ* green sunhemp	44.79	60.56
2. Broad bed furrows + *in situ* green sunhemp	43.65	58.91
3. Flat bed + *in situ* green sunhemp	41.87	56.04
SE (m) ±	0.48	0.59
CD at 5%	1.40	1.73
B – Nutrients Management		
1. 00:00:00 kg NPK ha^{-1}	19.96	29.96
2. 90:45:45 kg NPK ha^{-1}	47.40	61.13
3. 120:60:60 kg NPK ha^{-1}	52.28	68.27
4. 150:75:75 kg NPK ha^{-1}	54.10	74.67
SE (m) ±	0.55	0.68
CD at 5%	1.62	2.00

Interaction

Nutrients Management	**Mechanical Measures**					
	RF+GS*	BBF+GS	FB+GS	RF+GS	BBF+GS	FB+GS
00:00:00 kg NPK ha^{-1}	21.24	20.44	18.20	31.66	30.74	27.45
90:45:45 kg NPK ha^{-1}	48.91	47.98	45.30	62.77	61.73	58.88
120:60:60 kg NPK ha^{-1}	52.59	52.37	51.88	69.42	68.94	66.43
150:75:75 kg NPK ha^{-1}	56.40	53.78	52.11	78.39	74.22	71.38
SE (m) ±		0.95			1.17	
CD at 5%		2.84			-	

* GS = Green *in situ* of sunhemp

REFERENCES

Gable, D. B., K. J.Kudbe,J. R.Katore,A. V. Fiske and M. R.Deshmukh, 2008. Effect of INM on growth and yield of maize – chickpea cropping system. J. Soils and Crops.**18**(2): 392-397.

Jackson, M. L.1973.Soil chemical analysis.Prentice Hall of India, Pvt. Ltd. New Delhi. pp. 151-153**.**

Karunadevi, G. Idapuganti, P. S. Mankar, V. S. Khawale, C. P. Datey and S. N. Gaidhane, 2007.Effect of land configuration and weed biomass addition on growth and yield of semi-*rabi* pigeonpea. J. Soils and Crops.**17**(1):114-116.

Kumawat,S., A.C.Sadhu, Seema Sharma and Hansal Akhran, 2016. Effect of different fertility levels and weed management practices on productivity, profit, soil fertility and weed dynamics in winter maize. Green farming Int. J.**7**(3):615-618.

Manwar, B.P. and D.D.Mankar,2015 . Effect of land configuration and fertilizer management in *kharif* maize (*Zea mays* L.). J. Soils and Crops. **25** (1): 220-225.

Rajashekarappa, K.S., B.E. Dasavarajappa and Puttaiah, 2014.Effect of different organic mulches and *in-situ* green manuring on soil properties,yield and economics of maize in dry zone of Karnataka. Green farming Int. J. **5**(1): 61-64.

Ram, K.V., A.D.Raj and P.M.Shukla,2022.Effect of nitrogen, phosphorus and potassium on growth, yield and economics on hybrid maize (*Zea mays* L.) under south Gujrat condition. J. Soils and Crops). **32** (1): 80-86.

Shah, R. A. and B. A. Wani , 2017. Yield, nutrient uptake and soil fertility of maize (*Zea mays* L.*)* as influenced by varying nutrient management Practices under temperate conditions. Plant Archives. **17**(1): 75-78.

Subbiah, B.V. and G.L. Asija, 1956. A rapid procedure for determination of available nitrogen in soil. Curr. Sci. **25**: 256-260.

Rec. on 05.11.2022 & Acc. on 08.12.2022