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Effect of varied levels of NPK fertilizer management on growth, yield and yield attributes of maize in maize based intercropping systems under Southern Transitional zone of Karnataka

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Abstract
A field experiment was conducted at Agricultural and Horticultural Research Station, Keladi Shivappa Nayaka University of Agricultural and Horticultural Sciences, Bhavikere, Karnataka during *Kharif* season of 2019 and 2020 to "Studies on NPK dynamics in soil under maize and groundnut based intercropping systems in rainfed situation" and The experiment was laid out in split-plot design in which intercropping systems as three main plot (M) *viz*., M_1-Maize sole crop, M_2-Maize+Soyabean intercrop (4:2), M_3-Maize+redgram intercrop (8:2) and NPK level as five subplot treatment (S) *viz*., S_1: Control, S_2: Rec. NPK, S_3: 75% of Rec. NPK + Rec. FYM, S_4: 100% of Rec. NPK + Rec. FYM, S_5: 125% of Rec. NPK + Rec. FYM with three replications involving fifteen treatments. Grain and stover yields of maize was significantly higher (6281.7 kg ha^{-1} and 7370.3 kg ha^{-1}, respectively) with application of 125 percent recommended NPK with 7.5 t ha^{-1} recommended FYM as compared to rest of the treatment. Plant height, cob length, cob weight and 100 grain weight was also recorded in the same treatment.

Keywords: Intercrop, NPK level and maize

Introduction

Intercropping is age old practices in agriculture. In the present situation, increasing agricultural production through extensive agriculture production has limited scope due to limited availability of cultivable area. In India area of 143.8 m ha out of 329 m ha of geographical area is at present under cultivation and further expansion of cultivable area is extremely difficult. Under these circumstances, to meet the requirement of food grains for ever increasing population, the only option open is through time and space utilization in agriculture. Intercropping system which involves rising of more than one crop on the same piece of land more or less simultaneously increases the cropping intensity both in space and time dimensions. In the recent day's agriculture, increased interest in sustainability and environmental concern has diverted towards intercropping system for better utilization of resources and improvement in soil fertility.

In recent day, crop production, more attention has been given for diversification of crops as a means of intercropping system. The main reasons for popularity of intercropping among farmers are: Sowing and planting dates are arranged to optimize the crop requirement, higher output per unit area, maximum utilization of land resource, minimizing of risk and offer a more depended return, soil is covered for longer period with crops, effective utilization of biological nitrogen fixation, improved crops protection by altered microclimate, proper utilization of resources to suppress the weeds problems.

In the present context of agricultural scenario cultivation of two or more crops simultaneously on the same field for higher yield and economic returns is important as per capita availability of cultivable land has been shrinking due to increasing demographic pressure. Intercropping system offers a chance to increase cropping intensity as two or more crops occupy the land simultaneously. Intercropping, one type of a multiple cropping system, is recommended to be used in many parts of the world for food or fiber production, because of its overall high productivity, effective control of pests and diseases, good ecological services and economic profitability (Wu and Wu, 2014; Midega *et al.*, 2014; Xia *et al.*, 2013) [11, 7, 12].

Cereal-legume intercropping is a more productive and profitable cropping system in comparison with solitary cropping (Evan *et al.*, 2001) [3]. Having adventure roots, grasses need nitrogen for fast growth. If legumes produce good nodule in intercropping, much parts of nitrogen that grasses need was available (Ibrahim and Kabesh, 1971) [6]. The yield advantage in cereal legume intercropping was due to their differential rooting habit, differential demand for resources at different periods of growth and nitrogen fixation by legumes. Legume inclusion in cereal based intercropping helps to increase the productivity per unit land by extracting moisture and nutrients from deeper layers of soil and will help in combating the problem of weeds, pests and diseases.

Nutrients management and optimum fertilizers schedule have mainly been on sole cropping. The competition for nutrients occurs only at peak growth stages, it can begin during the early growth period of the component crop (Ghosh *et al.*, 2006) [4]. Fertilizer recommendation based on sole cropping may not to meet the nutrients demand of the component crops in the intercropping system, due to competition between component crops for nutrients. Intercropping systems involving cereals and legume crops are common in India. The inclusion of legume in intercropping increasing the total productivity and plays an important role in economizing the resource use, especially N. It has been estimated that with the inclusion of legume in intercropping system, the, extent of N addition would be 0.746 million tonnes. The component crops in this combination have different requirements of nutrients. Cereals have less P, but high N requirement. Most legumes possess effective mechanism for symbiotic N fixation but have high P requirement, hence assessment of fertilizers requirement become complex. Therefore there is a need for assessing the competition between component crops for nutrients use and to find out the appropriate fertilizer nutrients dose for the system based competition so that could meet the nutrients requirements of crops in the system.

The maize area in Karnataka has almost doubled during the past one decade and currently it is the largest among all the states in India and also leading producer and exporter with a contribution of about 19 percent (4 mt) from 15 percent of maize area (1.33 m ha) with productivity of 2.90 lakh ha^{-1} (Anon., 2018) [1]. Maize being a C4 crop produces higher dry matter, having ability to suppress weeds and high adaptability to both rainfed and irrigated situations have favored expansion of maize area in the state. Maize crop in Southern Transition Zone-7 is being grown as monocrop in an area of 2.8 lakh ha. Continuous growing of maize over the years has resulted in declining of soil fertility and health due to its exhaustive nature.

Maize crop has wider adaptability and compatibility under diverse soil and climate conditions. Therefore, it is cultivated in sequence or in association with different crops of different growth habit under varied agro ecologies of the country and hence regarded as one of the potential drivers of crop diversification. It is often intercropped with soybean, ground nut, green gram, cowpea, pigeonpea and field bean *etc*. Intercropping of maize with legumes such as cowpea, greengram, blackgram, and pigeonpea not only improved the productivity and profitability, but the incorporation of legume residues also resulted in saving of about 25 to 30 kg N ha^{-1}.

Material and Methods

Field experiment was conducted at Agricultural and Horticultural Research Station, Keladi Shivappa Nayaka University of Agricultural and Horticultural Sciences, Bhavikere, Karnataka. The texture of soil was red sandy loam having neutral pH (6.04) with organic carbon (0.65%), available nitrogen (195.25 kg ha^{-1}), phosphorous (30.56 kg ha^{-1}) and potassium (136.28 kg ha^{-1}). The experiment was laid out in split-plot design in which intercropping systems as three main plot (M) *viz*., M_1-Maize sole crop, M_2-Maize+Soyabean intercrop (4:2), M_3-Maize+redgram intercrop (8:2) and NPK level as five subplot treatment (S) *viz*., S_1: Control, S_2: Rec. NPK, S_3: 75% of Rec. NPK + Rec. FYM, S_4: 100% of Rec. NPK + Rec. FYM, S_5: 125% of Rec. NPK + Rec. FYM with three replications involving fifteen treatments. Growth, yield and yield attributes of maize *viz*., plant height, grain yield, stover yield harvest index, cob length, cob weight, test weight were recorded in the study. Maize equivalent yield as influenced by cropping systems and nutrient management was calculated. The experimental results were analyzed and the data interpretation was done by split plot design of analysis of variance. The data collected from the experiment at different growth stages and at harvest were subjected to statistical analysis as described by Gomez and Gomez (1984) [5].

Results and Discussion

Growth parameters of maize as influenced by cropping systems and nutrient management.

The growth parameter such as plant height of maize as influenced by varying levels of nutrients is presented in Table 1. The data revealed that, plant growth parameters were increased with increase in nitrogen levels at 30, 60, 90 DAS and at harvest. At higher levels of recommended NPK, growth attributes exhibited significant differences and progressively increased up to harvest respectively.

Plant height (cm)

Irrespective of the varied levels of nutrient management and cropping system, plant height increased across different physiological stages of crop *viz*., 30, 60, 90 days after sowing (DAS) and at harvest.

Among different intercropping systems, the maize sole crop recorded significantly higher plant height (38.95, 153.67, 226.78 and 233.04 cm) compared to Maize + soybean (36.02, 139.90, 195.78 and 200.64 cm) and it was on par with Maize + redgram (37.84, 152.66, 223.27 and 228.50 cm) at 30, 60, 90 days after sowing (DAS) and at harvest, respectively. Among the nutrient management practices, the plant height varied significantly and the treatment received 125% of Rec. NPK + Rec. FYM recorded significantly higher plant height (48.95, 159.30, 236.78 and 243.31 cm) compared to rest of the treatments at 30, 60, 90 days after sowing (DAS) and at harvest, respectively. Significant differences were observed due to interaction effects of cropping systems and nutrient management on plant height at all the stages and varied 50.31 (M_1S_5) to 27.13 cm (M_2S_1), 166.37 (M_1S_5) to 130.29 cm (M_1S_1), 242.59 (M_1S_5) to 172.31 cm (M_2S_1) and 249.56 (M_1S_1) to 175.83 cm (M_2S_1) at 30, 60, 90 days after sowing (DAS) and at harvest, respectively.

The rate of increase in plant height was sharp between 30 to 90 DAS, beyond which it was only marginal increase up to harvest. Plant height reflects the vegetative growth behavior of crop plants to applied inputs. Increase in plant height of maize may be attributed to elevated and balanced application of nutrients which might have enabled the crop to absorb adequate amount of major nutrients *viz*., N, P and K (Muoneke and Asiegbu, 1997) [8].

Yield and yield components of maize as influenced by different levels of nutrient in maize based intercropping system

The yield and yield parameters of maize varied significantly due to different nutrient management practices in maize based intercropping system. The data is presented in Table 2 and Table 3

Among the different intercropping systems, the maize sole crop recorded significantly higher grain yield (5882.0 kg ha^{-1}) and straw yield (7143.68 kg ha^{-1}) as compared to maize + soybean (4057.6 and 4984.63 kg ha^{-1}) and it was on par with maize + red gram (5537.3 and 6722.46 kg ha^{-1}), respectively. (Table 3)

Whereas among the varied level of Rec. NPK+ Rec. FYM, treatment receiving 125% of Rec. NPK + Rec. FYM recorded significantly higher grain (6281.7 kg ha^{-1}) and straw yield (7370.35 kg ha^{-1}) compared to all other treatments. However significant differences were observed due to interaction effects of cropping systems and nutrient management on grain yield and straw yield. The treatment (M_1S_5) Maize sole crop which received 125% of Rec. NPK + Rec. FYM was recorded significantly higher grain yield (7224.1 kg ha^{-1}) and straw yield (8391.46 kg ha^{-1}) compared to rest of the treatments.

Among the different cropping systems, non-significant difference was observed but numerically the maize sole crop recorded higher cob length (18.11 cm) and cob weight (318.94 g) as compared to maize + soybean cob length (17.03 cm) and cob weight (306.53 g) and it was on par with maize + red gram cob length (17.82 cm) and cob weight (309.75 g), respectively. Whereas significantly higher test weight was recorded in maize sole crop (31.94 g) compared to maize + soybean (29.24 g) and it was on par with maize + red gram (30.39 g), respectively. (Table 2)

However, among the different nutrient management practices significantly higher yield attributing character *viz.*, cob length (19.14 cm), test weight (34.50 g), cob weight (331.38 g) were recorded in the treatment received 125% of Rec. NPK + Rec. FYM (S_5) as compared to all other treatments. There was a non significant differences were observed due to interaction effects on cob length, test weight and cob weight.

The increased maize yield under intercrop was due to nitrogen contribution from pulses as legume crop having N fixing capacity and also due to microclimate of intercrops favoured the optimum growth and development of maize. Maize is shallow rooted crop which absorb the nutrients from upper layer of the soil. While, redgram crop being a deep rooted absorbs the nutrient from deeper layer of soil. Increase in yield might be due to better plant performance with optimum levels of fertilizer which was responsible for increased cell division, multiplication and better photosynthetic activity which helped in increase in dry matter production and which also enhanced better root development and resulted in profuse shoot and root growth there by activating absorption of these nutrients from soil in turn ultimately resulted in yield of maize. (Bakht *et al.*, 2006) [2].

Singh *et al.* (2003) [10] also reported positive influence with higher levels of fertilizers for yield in base crop. Further, substantial role of well fertilized legume component with respect to transfer of nutrients towards the maize crop also was a reality. Similar findings were also reported by Shivay *et al.* (1999) [9]. The similar relationship obtained yet again for major nutrient uptake and yield. Higher values of yield attributing characters by application of higher nutrient levels were also reported earlier study by Muniswamy *et al.* (2007) [13].

The response of maize to fertilization levels showed that the grain yield of maize increased with increase in nutrient level. Significant increase in stover yield of maize with application of 125 percent RDF + FYM supplied to both main and component crops could be attributed directly to increased dry matter accumulation and indirectly to greater nutrient uptake under this treatment. It may be due to increased availability of nutrients which helped the plant to attain its maximum yield potential. Significantly higher biological yield with aforesaid fertilizer level could be ascribed to its positive influence on both vegetative and reproductive growth of crops which led to increase in grain and straw yield, thereby higher biomass production per hectare. Optimum levels of fertilizer to maize might have enhanced meristematic activities in maize by stimulating cell division and elongation of cells which reflected in the increased plant height and LAI, which in turn provided greater leaf surface for better inception, absorption and utilization of radiant energy which ultimately increased grain yield and straw yield with concomitant improvement in yield attributes.

Maize equivalent yield as influenced by cropping systems and nutrient management

To express yield advantage, the yield of individual crops is converted into equivalent yield of any crop based on their economic value. Data pertaining to maize equivalent yield as influenced by different nutrient management under maize based intercropping systems are presented in Table 4.

Among the maize based cropping systems, the maize + red gram recorded significantly higher maize equivalent yield (7978.3 kg ha^{-1}) compared to Maize + soybean (6424.4 kg ha^{-1}) and statistically lower yield was noticed with maize sole crop (5889.0 kg ha^{-1}), respectively. Whereas among the different nutrient management practices It was inferred from the results that significantly higher maize equivalent yield was noticed in plots received 125% of Rec. NPK + Rec. FYM (8110.4 kg ha^{-1}) compared to rest of the treatments. Significant differences were observed due to interaction effects on maize equivalent yield. The maize + redgram intercropping systems recorded significantly higher maize equivalent yield (9658.7 kg ha^{-1}) with the application of 125 percent recommended dose of fertilizer along with farm yard manure as compared to rest of the combinations. This may be also due to efficient utilization of resources resulting in better productivity. Higher grain yield of component crops (soybean and redgram) owing to optimum nutrient availability (125 percent of Rec. NPK + Rec. FYM to both the component crops) coupled with higher price of both the crops contributed to higher maize equivalent yield. Similar results were also reported by Hugar and Palled (2008) [14]. In addition to this significant increase in maize equivalent yield was because of increased levels of fertilizers to main and inter crop which appears to be the result of higher productivity of both maize and intercrops.

Table 1: Plant height (cm) at different growth stages of maize as influenced by varied levels of NPK under maize based intercropping system

Treatments	30 DAS			60 DAS			90 DAS			At harvest		
	2019	2020	Pooled	2019	2020	Pooled	2019	2020	Pooled	2019	2020	Pooled
Main plot: Cropping systems												
M_1: Maize sole crop	37.78	40.12	38.95	151.19	156.15	153.67	226.00	227.55	226.78	232.42	233.65	233.04
M_2: Maize + soybean (4:2)	34.60	37.44	36.02	137.98	141.82	139.90	195.00	196.56	195.78	200.02	201.26	200.64
M_3: Maize + redgram (8:2)	36.62	39.06	37.84	151.18	154.14	152.66	222.54	224.00	223.27	227.88	229.12	228.50
S. Em±	0.68	0.73	0.7	2.73	2.8	2.76	4.05	4.08	4.07	4.15	4.17	4.16
C. D @ 5%	2.68	NS	NS	10.71	10.98	10.85	15.92	16.03	15.97	16.29	16.38	16.34
Sub plot: Nutrient management												
S_1: Control	26.60	29.14	27.87	130.78	133.91	132.35	184.37	185.78	185.08	189.13	190.36	189.75
S_2: Rec. NPK	35.63	38.18	36.91	150.82	154.20	152.51	218.50	220.23	219.36	224.77	225.98	225.37
S_3: 75% of Rec. NPK + Rec. FYM	32.77	35.29	34.03	143.91	147.11	145.51	212.00	213.42	212.71	215.47	216.69	216.08
S_4: 100% of Rec. NPK + Rec. FYM	39.00	41.53	40.26	151.83	156.26	154.05	221.73	223.17	222.45	228.5	229.75	229.13
S_5: 125% of Rec. NPK + Rec. FYM	47.67	50.24	48.95	156.57	162.03	159.30	235.97	237.59	236.78	242.67	243.94	243.31
S. Em±	0.51	0.55	0.53	2.13	2.19	2.16	3.09	3.12	3.1	3.17	3.19	3.18
C. D @ 5%	1.49	1.6	1.55	6.22	6.38	6.3	9.03	9.09	9.06	9.27	9.32	9.29
Interaction												
M_1S_1	27.80	30.10	28.95	128.75	131.83	130.29	192.3	193.76	193.03	198.5	199.73	199.12
M_1S_2	37.30	39.67	38.49	156.80	162.91	159.86	233.5	235.16	234.33	239.5	240.67	240.09
M_1S_3	34.60	36.91	35.76	146.80	152.44	149.62	225.2	226.7	225.95	231.3	232.48	231.89
M_1S_4	40.10	42.42	41.26	159.50	164.92	162.21	237.3	238.66	237.98	243.9	245.16	244.53
M_1S_5	49.10	51.51	50.31	164.10	168.64	166.37	241.71	243.47	242.59	248.9	250.21	249.56
M_2S_1	25.70	28.55	27.13	131.20	134.81	133.01	171.5	173.11	172.31	175.2	176.46	175.83
M_2S_2	33.40	36.28	34.84	140.37	141.37	140.87	193.7	195.66	194.68	198.3	199.5	198.9
M_2S_3	31.00	33.80	32.40	138.63	139.56	139.1	183.1	184.34	183.72	187.5	188.77	188.14
M_2S_4	37.60	40.42	39.01	137.40	142.22	139.81	195.6	197.01	196.31	201.7	202.93	202.32
M_2S_5	45.30	48.17	46.74	142.30	151.15	146.73	231.1	232.66	231.88	237.4	238.64	238.02
M_3S_1	26.30	28.76	27.53	132.40	135.1	133.75	189.3	190.48	189.89	193.7	194.9	194.3
M_3S_2	36.20	38.60	37.40	155.30	158.32	156.81	228.3	229.86	229.08	236.5	237.76	237.13
M_3S_3	32.70	35.16	33.93	146.30	149.33	147.82	227.7	229.21	228.46	227.6	228.82	228.21
M_3S_4	39.30	41.74	40.52	158.60	161.65	160.13	232.3	233.84	233.07	239.9	241.16	240.53
M_3S_5	48.60	51.03	49.82	163.30	166.3	164.8	235.1	236.63	235.87	241.7	242.98	242.34
S. Em±	0.89	0.95	0.92	3.69	3.79	3.74	5.36	5.4	5.38	5.5	5.53	5.51
C. D @ 5%	NS	NS	NS	10.78	NS	NS	15.64	15.75	15.69	16.05	16.14	16.1

Table 2: Cob length, cob weight and test weight of maize as influenced by varied levels of NPK under maize based intercropping system

Treatments	Cob length (cm)			Test weight (g)			Cob weight (g)		
	2019	2020	Pooled	2019	2020	Pooled	2019	2020	Pooled
Main plot: Cropping systems									
M_1: Maize sole crop	17.3	18.91	18.11	31.1	32.77	31.94	321.44	316.43	318.94
M_2: Maize + soybean (4:2)	16.02	18.04	17.03	27.92	30.56	29.24	304.42	308.64	306.53
M_3: Maize + redgram (8:2)	17.02	18.61	17.82	29.26	31.52	30.39	307.51	312	309.75
S. Em±	0.31	0.34	0.32	0.56	0.59	0.58	5.67	5.72	5.7
C. D @ 5%	1.2	NS	NS	2.21	NS	2.27	NS	NS	NS
Sub plot: Nutrient management									
S_1: Control	15.61	16.41	16.01	21.5	25	23.25	272.91	274.39	273.65
S_2: Rec. NPK	16.47	18.22	17.34	30.91	32.86	31.89	309.59	313	311.3
S_3: 75% of Rec. NPK + Rec. FYM	16.81	18.17	17.49	28.83	31.27	30.05	318.34	317.61	317.98
S_4: 100% of Rec. NPK + Rec. FYM	17.33	19.2	18.27	32.13	33.72	32.93	323.81	324.97	324.39
S_5: 125% of Rec. NPK + Rec. FYM	17.68	20.61	19.14	33.76	35.24	34.5	330.95	331.82	331.38
S. Em±	0.24	0.27	0.25	0.43	0.46	0.44	4.54	4.55	4.54
C. D @5%	0.71	0.78	0.74	1.25	1.34	1.3	13.24	13.27	13.25
Interaction									
M_1S_1	16.4	17.12	16.76	22.5	25.33	23.92	282.7	278.3	280.5
M_1S_2	16.6	17.84	17.22	33.23	34.33	33.78	320.4	317.56	318.98
M_1S_3	17.53	18.85	18.19	30.3	32.71	31.51	328	321.44	324.72
M_1S_4	17.8	19.55	18.68	34.1	35.12	34.61	333.8	328.36	331.08
M_1S_5	18.17	21.21	19.69	35.37	36.37	35.87	342.3	336.51	339.41
M_2S_1	14.3	15.21	14.76	20.7	24.63	22.67	267.07	271.35	269.21
M_2S_2	16.3	18.23	17.27	28.3	31.33	29.82	302.83	309.25	306.04
M_2S_3	15.6	17.55	16.58	27.1	29.93	28.52	312.87	313.86	313.36
M_2S_4	16.8	18.95	17.88	30.8	32.17	31.48	316.13	320.3	318.22
M_2S_5	17.1	20.27	18.69	32.7	34.73	33.72	323.18	328.45	325.82
M_3S_1	16.13	16.89	16.51	21.3	25.03	23.17	268.97	273.53	271.25
M_3S_2	16.5	18.58	17.54	31.2	32.91	32.06	305.53	312.2	308.87
M_3S_3	17.3	18.12	17.71	29.1	31.17	30.13	314.17	317.53	315.85
M_3S_4	17.4	19.11	18.26	31.5	33.87	32.68	321.5	326.25	323.88
M_3S_5	17.77	20.35	19.06	33.2	34.63	33.92	327.37	330.5	328.93
S. Em±	0.42	0.46	0.44	0.74	0.8	0.77	7.86	7.87	7.86
C. D @ 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 3: Grain yield, stover yield and harvest index of maize as influenced by varied levels of NPK under maize based intercropping system

Treatments	Grain Yield (kg/ha)			Stover Yield (kg/ha)			Harvest Index		
	2019	2020	Pooled	2019	2020	Pooled	2019	2020	Pooled
Main plot: Cropping systems									
M_1: Maize sole crop	5832.4	5931.7	5882.0	7091.8	7195.5	7143.6	0.451	0.451	0.451
M_2: Maize + soybean (4:2)	3998.9	4116.2	4057.6	4932.0	5037.2	4984.6	0.446	0.449	0.447
M_3: Maize + redgram (8:2)	5485.4	5589.1	5537.3	6671.0	6773.8	6722.4	0.450	0.451	0.450
S. Em±	99.3	101.3	100.3	120.4	122.2	121.3	0.008	0.008	0.008
C. D @ 5%	390.0	397.8	393.9	472.7	479.95	476.36	NS	NS	NS
Sub plot: Nutrient management									
S_1: Control	3625.5	3744.1	3684.8	4668.6	4776.8	4722.7	0.436	0.439	0.437
S_2: Rec. NPK	4702.8	4872.1	4787.4	5971.1	6075.1	6023.1	0.440	0.444	0.442
S_3: 75% of Rec. NPK + Rec. FYM	5247.5	5332.8	5290.1	6218.6	6321.4	6270.0	0.458	0.458	0.458
S_4: 100% of Rec. NPK + Rec. FYM	5701.4	5800.0	5750.7	6980.6	7082.6	7031.6	0.450	0.451	0.450
S_5: 125% of Rec. NPK + Rec. FYM	6250.8	6312.7	6281.7	7319.1	7421.5	7370.3	0.460	0.459	0.460
S. Em±	72.7	74.4	73.6	89.1	90.6	89.9	0.007	0.007	0.007
C. D @5%	212.3	217.2	214.7	260.2	264.5	262.41	NS	NS	NS
Interaction									
M1S1	4139.8	4225.1	4182.5	5093.5	5198.5	5146.0	0.448	0.448	0.448
M1S2	5437.3	5622.6	5530.0	6682.2	6785.2	6733.7	0.449	0.453	0.451
M1S3	5864.3	5949.6	5906.9	7302.9	7409.1	7356.0	0.445	0.445	0.445
M1S4	6523.9	6609.2	6566.5	8040.1	8142.1	8091.1	0.448	0.448	0.448
M1S5	7196.5	7251.8	7224.1	8340.4	8442.5	8391.4	0.463	0.462	0.463
M2S1	2850.8	3036.1	2943.4	3874.6	3986.6	3930.6	0.424	0.432	0.428
M2S2	3706.0	3891.3	3798.7	4877.8	4984.3	4931.1	0.432	0.438	0.435
M2S3	4160.7	4246.0	4203.4	4838.1	4939.6	4888.8	0.462	0.462	0.462
M2S4	4447.4	4532.7	4490.1	5333.1	5435.4	5384.2	0.455	0.455	0.455
M2S5	4829.8	4875.1	4852.4	5736.5	5840.0	5788.2	0.457	0.455	0.456
M3S1	3885.9	3971.2	3928.6	5037.6	5145.4	5091.5	0.435	0.436	0.436
M3S2	4965.0	5102.3	5033.7	6353.2	6455.9	6404.5	0.439	0.441	0.440
M3S3	5717.4	5802.7	5760.0	6514.8	6615.5	6565.2	0.467	0.467	0.467
M3S4	6132.7	6258.0	6195.4	7568.8	7670.4	7619.6	0.448	0.449	0.448
M3S5	6726.0	6811.3	6768.7	7880.5	7982.0	7931.3	0.460	0.460	0.460
S. Em±	126.0	128.9	127.4	154.43	157	155.72	0.011	0.011	0.011
C. D @ 5%	367.7	376.2	371.9	450.76	458.25	454.51	NS	NS	NS

Table 4: Maize Equivalent Yield as influenced by varied levels of NPK under maize based intercropping system

Treatments	Maize Equivalent Yield (kg/ha)		
	2019	2020	Pooled
Main plot: Cropping systems			
M_1: Maize sole crop	5846.4	5931.7	5889.0
M_2: Maize + soybean (4:2)	6223.5	6625.3	6424.4
M_3: Maize + redgram (8:2)	7804.9	8151.7	7978.3
S. Em±	131.2	136.6	133.9
C. D @ 5%	515.3	536.4	525.8
Sub plot: Nutrient management			
S_1: Control	4651.1	4969.1	4810.1
S_2: Rec. NPK	6198.8	6505.0	6351.9
S_3: 75% of Rec. NPK + Rec. FYM	6833.0	7093.1	6963.1
S_4: 100% of Rec. NPK + Rec. FYM	7460.3	7707.8	7584.0
S_5: 125% of Rec. NPK + Rec. FYM	7981.4	8239.5	8110.4
S. Em±	93.0	97.0	95.0
C. D @5%	271.3	283.1	277.2
Interaction			
M_1S_1	4139.8	4225.1	4182.5
M_1S_2	5537.3	5622.6	5580.0
M_1S_3	5864.3	5949.6	5906.9
M_1S_4	6723.9	6809.2	6766.5
M_1S_5	6966.5	7051.8	7009.1
M_2S_1	4417.2	4900.2	4658.7
M_2S_2	5840.3	6259.5	6049.9
M_2S_3	6465.6	6853.0	6659.3
M_2S_4	6916.6	7264.7	7090.7
M_2S_5	7477.8	7849.2	7663.5
M_3S_1	5396.3	5782.0	5589.2
M_3S_2	7218.7	7632.7	7425.7
M_3S_3	8169.2	8476.8	8323.0
M_3S_4	8740.3	9049.4	8894.9
M_3S_5	9500.1	9817.4	9658.7
S. Em±	161.0	168.0	164.5
C. D @ 5%	470.0	490.3	480.1

Conclusion
Thus, it can be concluded that application the treatment which received 125 percent of recommended NPK + recommended FYM (7.5 tha^{-1}) recorded significantly higher maize grain yield (4852.4 kg ha^{-1}) in maize + soybean intercrop (4:2) and in maize + red gram intercrop (8:2) (6768.7 kg ha^{-1}) as compared to rest of the treatments.

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