INTERNATIONAL JOURNAL OF SCIENCE AND NATURE

www.scienceandnature.org

EFFECT OF INTERCROPPING SYSTEM AND NITROGEN MANAGEMENT PRACTICES ON NUTRIENT UPTAKE AND POST-HARVEST SOIL FERTILITY

*[1]Rekha, R.G., [1]Desai, B.K., [1]Satyanarayan Rao, [1]Umesh, M.R. & [2]Shubha, S.
[1]Department of Agronomy, [2]Department of microbiology, University of Agricultural Sciences, Raichur-584 104 Karnataka (INDIA)
*Corresponding author email: rgrekha6@gmail.com

ABSTRACT
Field experiment was conducted at the IFS farm UAS Raichur, to study the effect of source of nitrogen and intercropping systems on the nutrient uptake and post-harvest soil fertility during *kharif* 2015. The experiment was laid out in split plot design with five main treatments and three sub-treatments, replicated thrice. The experimental results revealed that uptake of NPK and available NPK was significantly influenced due to intercropping systems and nitrogen management practice. Significantly higher uptake of N and P was recorded with baby corn + clusterbean and significantly higher uptake of K was recorded by baby corn + okra. Among nitrogen management practices application of 100% RDN through chemical fertilizer recorded significantly higher N uptake, where as P and K with application of 50% RDN through goat manure + 50% RDN through poultry manure. Post harvest soil fertility in terms of available nutrients was significantly higher under sole baby corn and among nitrogen management practices, with application of 50% RDN through goat manure + 50% RDN through poultry manure.

KEY WORDS*:* baby corn, nutrient uptake, RDN and soil fertility.

INTRODUCTION

Maize (*Zea mays* L.) is the third most important cereal crop next to rice and wheat in India and also a predominant cereal in global agricultural economy. It has got immense yield potential and is therefore called as "miracle crop" and also "queen of cereals". Maize being a C4 plant, it is an efficient converter of absorbed nutrients into food. Maize is classified into different groups or types based on the endosperm of kernels among which baby corn is grown for vegetable purpose. Importance of maize as vegetable is little known to the Indian farmers in spite of the fact that it fetches very lucrative price in national and international markets. Thailand and China are the world's leading countries in baby corn production. Baby corn cultivation is now picking up in some states of India (Ramachandrappa *et al.,* 2004). With rapid increase in population and less chance of bringing new land under cultivation, intercropping seems to be the only way to increase productivity and intensity land use. This situation warrants developing an appropriate technology of growing cereals in association with vegetables without too much intercrops interference and competition. Presently, the chemical fertilizers are considered as the major source of nutrients. However, the escalating input cost, coupled with increasing usage of chemical fertilizers and depleting soil health necessitates the safe and efficient use of organics in crop production. The application of chemical fertilizer may assist in obtaining maximum production of baby corn but keeping in mind that chemical fertilizer may lead to hazardous effect on environmental health beside increasing production cost due to its being expensive, as such the judicious uses of fertilizers from different source on crop or baby corn will maintain the environmental sustainability for generations used without affecting the environmental health and improves soil fertility (Auwal, 2014).

MATERIALS & METHODS

The field experiment nitrogen management studies on baby corn based vegetable intercropping systems was carried out to during *kharif* 2015 at IFS farm, University of Agricultural Sciences, Raichur. Experiment was laid down in Split Plot Design with three replications. Main plot treatments includes baby corn + clusterbean (M_1), baby corn + okra (M_2), baby corn + coriander (M_3), baby corn + palak (M_1) and sole baby corn and sub plot treatments are 100% RDN through chemical fertilizer (S_1), 50% RDN through chemical fertilizer + 25% RDN through goat manure + 25% RDN through poultry manure (S_2) and 50% RDN through goat manure + 50 % RDN through poultry manure (S_3). The required quantities of poultry manure and goat manure were applied and incorporated in the plots before sowing as per the treatments. A recommended fertilizer dose of 150 : 75 : 37.5 kg NPK ha^{-1} of which 50 per cent N and full doses of P and K were applied as basal dose at the time of sowing and remaining dose of N was applied at 25 days after sowing as top dressing to the representative treatments. Shallow furrows were opened at 60 cm apart with the help of a marker. The seeds were hand dibbled uniformly on 21-08-2015. Intercrops were sown in between the crop rows of baby corn, and were covered with moist soil immediately after sowing. To control stem borer, phorate (10G granule) was applied in the whorls at 16 DAS and

chloropyriphos (2 ml litre^{-1}) was sprayed at 30 DAS for control of sucking pest in okra. Hand weeding was done at 15, 35 and 60 days after sowing and no herbicides were used due to different combination. The data recorded on various yield parameters, yield and economics were analysed following standard statistical analysis of variance procedure as suggested Panse and Sukhatme (1967).

RESULTS & DISCUSSION

The total uptake of nutrients was significantly higher in all the intercropping treatments compared to sole crop of baby corn. Among the intercropping treatments, baby corn + clusterbean (M_1) recorded significantly higher total N uptake (195.7 kg ha^{-1}) (Table 1) which might be due to clusterbean being a leguminous crop fixed the atmospheric nitrogen and made available to companion crop resulted in higher N uptake. The P uptake was significantly higher (32.1 kg ha^{-1}) in baby corn + clusterbean intercropping system (M_1). Whereas, higher total uptake of K (134.2 kg ha^{-1}) was recorded with baby corn + okra intercropping system (M_3), okra being exhaustive crop depleted more K resulted in higher uptake. Among different intercropping systems, lower total uptake of N, P and K was recorded with baby corn + coriander intercropping system (M_3), coriander being short durated crop nutrients applied to the soil were not much depleted (Aravinth *et al*., 2011). Application of 100% RDN through chemical fertilizer (S_1) recorded significantly higher nitrogen uptake (152.9 kg ha^{-1}). This might be due to steady and continuous availability of instant N in the rhizosphere (Meena *et al*., 2012). Leela Rani *et al.* (2011) revealed that RDN through fertilizer application recorded significantly higher nutrient uptake, over combined application of 75 per cent N through fertilizer + 25 per cent N through organic manure. Application of 50% RDN through goat manure + 50% RDN through poultry manure (S_3) recorded significantly lower nitrogen uptake (135.2 kg ha^{-1}). This was attributed to lesser availability of instant N in rhizosphere, due to relatively slow mineralization of organic sources. These results are in accordance with the findings of Arun Kumar *et al.* (2009) in baby corn. The uptake of P and K is recorded significantly highest (29.0 and 116.2 kg ha^{-1}) in the treatment 50% RDN through goat manure + 50% RDN through poultry manure (S_3), followed by 50 % RDN through chemical fertilizer + 25% RDN through goat manure + 25% RDN through poultry manure (S_2). It was the result of additional P and K supplied through manures, the solubilisation action of certain organic acids produced during decomposition and its greater capacity to hold K in available form in soil, due to the release of organic acids during microbial decomposition of organic matter that might have helped in solubility of native phosphorus (Table 2) and these findings are in conformity with Naidu *et al.* (2009).

TABLE 1. Total uptake of nitrogen, phosphorus and potassium as influenced intercropping practices and nitrogen management practices

Treatments	N uptake (kg ha^{-1})			P uptake (Kg ha^{-1})			K uptake (Kg ha^{-1})		
	Baby corn	Inter crop	Total	Baby corn	Inter crop	Total	Baby corn	Inter crop	Total
Intercropping system									
M_1: Baby corn + Clusterbean (1:1)	81.3	114.4	195.7	20.3	11.8	32.1	75.8	41.1	116.8
M_2: Baby corn + Okra (1:1)	79.9	103.1	183.0	18.6	9.0	27.6	73.7	60.5	134.2
M_3: Baby corn + Coriander (1:1)	95.9	16.3	112.2	22.5	1.3	23.8	88.9	8.3	97.2
M_4: Baby corn + Palak (1:1)	95.6	35.6	131.2	20.2	2.6	22.8	85.3	19.4	104.7
M_5: Sole baby corn	100.3	-	100.3	23.8	-	23.8	89.8	-	89.8
S.Em.±	2.4	1.3	2.6	0.7	0.1	0.7	1.9	0.8	1.7
C.D. (P=0.05)	7.9	4.7	8.3	2.4	0.4	2.2	6.1	2.8	5.5
Nitrogen application									
S_1: 100% RDN through chemical fertilizer	97.1	69.8	166.9	19.0	5.4	24.4	76.4	30.4	106.8
S_2: 50% RDN through chemical fertilizer + 25% RDN through goat manure + 25% RDN through poultry manure	91.0	67.9	158.9	20.9	6.1	27.0	83.0	32.0	115.0
S_3: 50% RDN through goat manure+ 50% RDN through poultry manure	83.6	64.4	148.0	23.3	7.0	30.3	88.6	34.5	123.1
S.Em.±	1.3	0.8	1.6	0.3	0.1	0.2	1.4	0.7	1.2
C.D. (P=0.05)	3.8	2.5	4.6	0.8	0.3	0.7	4.0	2.0	3.5
Interaction									
S.Em.±	3.4	2.9	3.8	0.9	0.3	0.8	3.1	1.9	2.7
C.D. (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS

NS: Non significant DAS: Days after sowing RDN: Recommended dose of nitrogen (150 kg ha^{-1})

Post harvest soil fertility status (Table 2 Fig. 1) was significantly higher with sole baby corn compared to intercropping systems due to higher population under intercropping system. Post harvest soil fertility status significantly improved with the application of 50% RDN through goat manure + 50% RDN through poultry manure (S_3). This might be owed to slow mineralization of organic matter coupled with under utilization of applied nutrients by baby corn. Such improvement of soil status with organic manures alone or in combination with chemical fertilizer has been reported by Keerthi *et al*. (2013). The lowest post harvest soil fertility status was found with supply of 100 per cent N through fertilizer, which was however, higher than initial values. Availability of nitrogen in soil with application of 100% RDN (S_1) resulted in higher baby corn yield and higher uptake of nitrogen and led to lower soil available nitrogen (238.4 kg ha^{-1}) (Table 2). Similar results on nutrient uptake and soil available nitrogen was reported by Arun Kumar *et al.* (2009) in baby corn.

The available phosphorus and potassium content of the soil was significantly higher (30.0 and 238.4 kg ha^{-1}) with 50% RDN through goat manure + 50% RDN through poultry manure (S_3). This is attributed to during decomposition of organic manure, various organic acids will be produced which solubilise phosphatase and other phosphate bearing minerals and thereby lowers the phosphate fixation and increase its availability The build up of soil available K due to application of manure may be due to additional K applied through manure and solubilising action of certain organic acids produced during decomposition and its greater capacity to hold K in the available form (Vidyavathi *et al*., 2012). Niranjan and Shiva (2015) observed that residual fertility in terms of available N, P_2O_5 and K_2O in the soil after crop harvest was significantly superior when recommended dose of N was applied through organic manure in comparison with recommended dose of N applied through fertilizer.

TABLE 2. Available soil nutrients at harvest as influenced intercropping systems and nitrogen management practices

Treatments	Nitrogen (kg ha^{-1})	Phosphorous (kg ha^{-1})	Potassium (kg ha^{-1})
Intercropping system			
M_1: Baby corn + Clusterbean (1:1)	132.1	26.0	214.6
M_2: Baby corn + Okra (1:1)	128.6	25.3	203.1
M_3: Baby corn + Coriander (1:1)	137.8	28.6	231.7
M_4: Baby corn + Palak (1:1)	136.5	28.2	230.9
M_5: Sole baby corn	152.9	31.4	243.8
S.Em.±	2.7	0.5	4.9
C.D. (P=0.05)	9.1	1.7	16.0
Nitrogen management practices			
S_1: 100% RDN through chemical fertilizer	130.2	25.8	212.5
S_2: 50% RDN through chemical fertilizer + 25% RDN through goat manure + 25% RDN through poultry manure	138.5	27.8	223.5
S_3: 50% RDN through goat manure+ 50% RDN through poultry manure	144.0	30.0	238.4
S.Em.±	2.3	0.6	3.1
C.D. (P=0.05)	6.7	1.6	9.1
Interaction			
S.Em.±	4.9	1.1	7.4
C.D. (P=0.05)	NS	NS	NS

NS: Non significant RDN: Recommended dose of nitrogen (150 kg ha^{-1})

CONCLUSION

Total available N, P_2O_5 and K_2O status of soil after harvest was higher with sole baby corn (M_5). Among intercropping system higher available nutrients were recorded with baby corn + coriander intercropping system (M_3). Significantly higher available N, P_2O_5 and K_2O were recorded with application of 50% RDN through goat manure + 50% RDN through poultry manure (S_3). The total uptake of nitrogen and phosphorus in baby corn + clusterbean intercropping system was significantly higher as compared to sole crop of baby corn and other intercropping system. However, the highest total uptake of potassium was recorded in baby corn + okra intercropping system (M_2). Among nitrogen management practices application of 100% RDN through chemical fertilizer (S_1) has recorded significantly higher nitrogen uptake.

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