The Andhra Agric. J 58(4): 464-466, 2011

Effect of Long Term Application of Manure and Fertilizers on Soil Available Secondary Nutrients in Alfisol of Groundnut

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ABSTRACT

The status of nutrients- their depletion and build-up in soil and crop productivity after thirty years (1981-2010) of intensive cropping were studied under continuous use of various inorganic fertilizers and organic manure in an Alfisol. Results showed that application of NPK (20:10:25 kg ha^{-1}) + gypsum +$ZnSO_4$ resulted in pod yield of 828 kg $ha^{-1}$of pod while FYM treatment plot produced 774 kg $ha^{-1}$of pod yield. However the fertility of soil appears to be adversely affected due to the imbalanced use of macronutrients. The secondary nutrient calcium was applied through Lime or gypsum. Thus, the balanced use of fertilizers continuously either alone or in combination with organic manure is necessary for sustaining soil fertility and productivity of crops.

Key words : Groundnut, Long term fertilization,Secondary nutrients.

In commercial agriculture, the use of chemical fertilizers cannot be ruled out completely. However, there is a need for application of alternative sources of nutrient for sustaining the desired crop productivity (Tiwari, 2002). Groundnut is an important oil seed crop grown under rainfed conditions in Andhra Pradesh. The challenge of improving the productivity in rainfed areas can be addressed by efficient utilization of nutrients by crops (Acharya, 2002). An ideal soil for groundnut production is well-drained, light coloured loose and friable sandy loam. Groundnut being a calcicole in nature, demands more calcium (Seshadri, 1962).

High requirements for calcium, sulphur and boron for physiological processes like pegging, pod filling, kernel formation and yield was also stressed by Gupta and Singh (1977). Application of gypsum increased seedling vigour, pod filling, kernel yield and quality of groundnut (De *et al,* 1982). Crude protein content as well as cysteine and methionine amino acids in groundnut increased with the improved calcium and sulphur nutrition (Badiger *et al,* 1982).

MATERIAL AND METHODS

The present investigation was carried out during *kharif* 2010 from long term experiment which was initiated in 1981 on red sandy loam soil at Regional Agricultural Research Station, Tirupati with eleven treatments *viz.,* T_1 : Control (no manure or fertilizers), T_2 : Farm yard manure @ 5 t ha^{-1} (once in 3 years), T_3 : 20 kg nitrogen (N) ha^{-1}, T_4 : 10 kg phosphorus (P) ha^{-1}, T_5 : 25 kg potassium (K) ha^{-1}, T_6 : 250 kg Gypsum ha^{-1}, T_7 : 20 kg N + 10 kg P ha^{-1}, T_8 : 20 kg N + 10 kg P + 25 kg K ha^{-1}, T_9 : 20 kg N + 10 kg P + 25 kg K + 250 kg Gypsum ha^{-1} at flowering stage, T_{10} : 20 kg N + 10 kg P + 25 kg K + 100 kg lime ha^{-1} at flowering stage, T_{11} : 20 kg N + 10 kg P + 25 kg K + 250 kg gypsum ha^{-1} + 25 kg zinc sulphate ha^{-1} (as basal, once in 3 years) in randomized block design and replicated four times.

The initial soil characters were as follows, the soil pH 6.7, EC 0.08 dSm^{-1}, OC 0.18% and NPK 180.3, 20.2 and 216.5 kg ha^{-1}, Ca, Mg and S 2.00, 0.9 cmol(p^+)$kg^{-1}$and 12.5 mg kg^{-1} respectively. Fertilizers were applied as per treatments *viz.,* NPK through urea, SSP and MOP respectively. Rainfed groundnut was raised during kharif 2010 adopting recommended package of practices. Gypsum and lime were applied at first bloom stage $ZnSO_4$ @ 25 kg ha^{-1} was applied as basal just one day before sowing. Soil samples were collected before sowing of the crop at two depths *i.e.,* 0-15 and 15-30 cms. Exchangeable calcium and magnesium were determined by Versenate method (Chopra and Kanwar, 1991) whereas available S was determined turbidimetrically using 0.15% $CaCl_2$ extractant (Cottenie *et al.,* 1979).

RESULTS AND DISCUSSION

Exchangeable calcium:

Calcium content of the soil at initial year was not influenced by difference in values of soil exchangeable Calcium after 30 years of cropping.

Table 1. Effect of long term application of manures and fertilizers on soil secondary nutrients (*kharif,* 2010).

Treatments	Exchangeable calcium (cmol (p+) kg^{-1})		Exchangeable Magnesium (cmol (p+) kg^{-1})		Sulphur (mg kg^{-1})	
	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm
T_1	1.83	2.13	1.78	2.28	18.27	15.60
T_2	2.45	2.64	1.65	1.84	20.24	18.13
T_3	2.46	3.00	1.14	1.74	21.34	18.17
T_4	2.78	3.16	1.66	2.30	21.39	19.17
T_5	2.32	2.80	1.04	1.44	21.46	19.88
T_6	2.89	3.35	1.28	1.72	22.66	19.64
T_7	2.23	3.20	1.56	1.96	22.84	22.00
T_8	2.68	2.98	2.13	2.34	24.34	23.30
T_9	2.77	3.40	1.38	1.94	46.20	39.14
T_{10}	3.80	4.10	1.34	1.78	25.14	24.00
T_{11}	3.56	3.90	1.40	1.72	43.10	36.43
SEm±	**0.11**	**0.11**	**0.11**	**0.11**	**1.60**	**1.78**
CD (P=0.05)	**0.32**	**0.32**	**0.31**	**0.28**	**4.62**	**5.14**

Table 2. Effect of long term application of manure and fertilizers on groundnut yield (*kharif,* 2010)

Treatments	Pod yield (kg ha^{-1})	Haulm yield (kg ha^{-1})	100 pod weight (g)	100 kernel weight (g)	Shelling percentage (%)
T_1	635	2445	69.9	31.1	68.1
T_2	774	3306	79.0	32.8	70.5
T_3	738	3205	78.9	32.0	70.4
T_4	743	2848	80.9	33.6	70.6
T_5	678	2633	80.0	31.3	70.0
T_6	657	2728	77.7	32.3	71.3
T_7	690	3006	78.2	32.7	70.9
T_8	722	3527	77.8	32.9	71.5
T_9	767	3445	78.4	33.3	70.6
T_{10}	733	2895	77.7	33.1	71.4
T_{11}	828	3318	78.2	32.2	69.3
SEm±	**37.19**	**4.24**	**2.73**	**0.66**	**1.47**
CD (P=0.05)	**107.40**	**NS**	**NS**	**1.34**	**NS**

The highest calcium content was observed in the treatment NPK+lime (T_{10}) NPK+gypsum+$ZnSO_4$ (T_{11}) gypsum alone treated plot (T_6). Significatly higher values were observed in treatments which received calcium in the form lime of gypsum. Application of gypsum during flowering stage is a common practice of the rayalaseema region to supply and calcium to the developing pod. Lowest calcium status was noticed in control, while the highest value obtained in combined application of NPK, lime, gypsum and zinc sulphate. The application of only chemical fertilizers to soil over along period decreases one of the important nutrients for groundnut. The lower percentage of depletion in control might be due to relatively poor crop growth and yield. Continuous application of calcium (T_6, T_9, T_{10} and T_{11}) resulted in increase in soil calcium status.

Exchangeable Magnesium:

The exchangeable magnesium content of the soil increased over initial values. This might be due to continuous cropping over years and mineralization of the soil organic matter (Suresh Lal and Mathur, 1998). Among the treatments the highest exchangeable magnesium contents were recorded with NPK, treated plot. This was in concurrence with the findings of Selvi *et al.,* 2003 who reported that exchangeable magnesium content of the soil increased significantly in plots receiving phosphorus compared to only application of N. Continuous incorporation and mineralization of crop residues also contributed for the build-up of the magnesium content when compared to the initial values.

Available Sulphur:

Available Sulphur content was higher in NPK+gypsum, NPK+gypsum+zinc sulphate where sulphur was added through gypsum or zinc sulphate. The increase in sulphur content at flowering may be attributed to the mineralization of native sulphur pool and application of SSP and gypsum which contain sulphur in treatments T_6, T_9 and T_{11}. The build-up of sulphur content in soil when compared to the initial 12.5 mg kg^{-1}. The build-up was observed due to external supply of the nutrients to the soil.

Pod Yield:

The treatment NPK+gypsum+zinc sulphate recorded highest yield when compared to others. The test weight was recorded highest in P alone treated plot, NPK+gypsum , NPK+lime. The haulm yield 100 kernel weight and shelling were non-significant.

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(Received on 16.06.2011 and revised on 03.08.2011)