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# Effect of poultry manure as partial substitute for P and S on the yield and quality of groundnut

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**Abstract:** A Potculture experiment was conducted to evaluate the yield and quality of groundnut with poultry manure as partial substitute for P and S. Poultry manure (PM) was integrated with chemical fertilizers (CF), SSP and elemental S at different ratios. There were six treatments replicated three times in a completely randomized design (T1-Control, T2-100%PM, T3-75% PM + 25% CF, T4-50% PM+50%CF,T5- 25% PM + 75% CF and T6 100%CF. Highest pot yield (45.50 g/pot) and oil content (45.2%) was obtained forT5 and Maximum protein content (12.50%) was recorded for T3.

**Keywords:** oil content, poultry manure, protein content, yield.

## Introduction

Groundnut *(Arachis hypogaea)* is an economically important and valuable oil seed crop cultivated extensively throughout the world. Groundnut prefers light-textured and well drained soils. The excellent soil group is sandy loam with a good supply of nutrients. In general these are deficient in nutrients. Therefore application of fertilizer is essential to increase the yield and quality of groundnut.

The nutrient removal by oilseeds crop was higher (N, P and K), while the contribution to nutrient uptake from fertilizer was low (Hegde, 2006). There is a growing deficiency of nutrients due to intensive cropping coupled with continuous use of high analysis fertilizers without any organic manure addition.

Phosphorus has a great role in energy storage and transfer and as a constituent of nucleic acid, phytin and phospholipids in plants. An adequate supply of phosphorus early in plant life is important for the reproductive parts of the plants. It plays an essential role in carbohydrate metabolism, fat metabolism and also in respiration of plants. The availability of phosphate in soils is often limited by fixation reactions, which convert the monophosphate ion to various insoluble forms. The availability of soil phosphate is enhanced by additions of organic manures, presumably due to chelation of polyvalent cations by organic acids and other decay products. Varalakshmi *et al.*, (2005) demonstrated that incorporation of farm yard manure along with inorganic phosphorus increases the availability of phosphorus and this is attributable to reduction in fixation of water soluble phosphorus, increased mineralization of organic phosphorus due to microbial action and enhanced mobility of phosphorus. The supply of P through manures not only provides enough P to growing plants but also increases the soil solution P (intensity factor, I) and quantity of available P (quantity factor, Q) (Patiram, 1993). In a study on the impact of FYM and poultry manure on P availability Rao (2003) observed that the available P content in soil increased significantly from 19.5 kg $ha^{-1}$ under control to 20.8 and 21.5 kg $ha^{-1}$ with 10 t FYM and 5 t poultry manure $ha^{-1}$, respectively.

Sulphur is recognized as the fourth major nutrient after nitrogen, phosphorus and potassium (Tandon, 1995). Field scale deficiencies of sulphur in soils and plants are becoming increasingly important. When a soil is deficient in sulphur, and this deficiency is not rectified, then the full potential of a crop variety cannot be realized regardless of the optimum supply of other nutrients and adoption of improved seeds or top class husbandry practices. Sulphur deficiency is mostly reported in coarse textured soils, in soils having low organic matter, in sites away from industrial activity associated with the emission of sulphur containing gases, in high rainfall areas, in crop rotations involving pulses and oilseeds and due to continuous use of sulphur free fertilizers (Tandon, 1995). Sulphur improves crop yields, oil percentage in oilseeds, plant proteins, etc. Radhamani *et al*. (2001) observed that oil content of sesame was higher with S application as compared to treatments without S application.

A field experiment conducted in loamy sand to study the individual and interaction effect of P and S on cluster bean showed that the levels of P and S significantly increased the seed and stover yield over control (Seshadri Reddy, 2005).On a sandy loam soil linseed crop responded to applied S and P applications with increased yields and oil content over control (Chaubey, 1992). The synergistic relationship between P and S was observed at 35 kg P and 50 kg S $ha^{-1}$ resulting in highest seed, straw and oil yields in both the years. Protein content also increased with P and S. Uptake of total and fertilizer P and S by soybean also enhanced significantly with the addition of P and S fertilizers to the soil. Higher utilization of fertilizer P and S were observed at their respective lower levels that increased significantly when both were applied together (Khajanchi Lal *et al*., 1996).

Soil fertility cannot be maintained with the application of inorganic fertilizers alone. Besides inorganic chemical fertilizers, there are several sources of plant nutrients like organic manures, crop residues, and industrial wastes. No single source can meet the increasing nutrient demands for agriculture. To achieve sustainability in production, there is a need to integrate both organic and inorganic sources of nutrients. Such an integration of nutrient sources will enhance the nutritional use efficiencies (Hegde and Sudhakarababu, 2001) besides maintaining soil fertility. Poultry manure occupied a place of pride as it is rich in nutrients than the other manures (Mohamad Amanullah *et al*. 2007). Vijaya Sankar Babu *et al*. (2007) concluded that the uptake of N, P, K, Ca and Mg was higher in poultry manure and fertilizer treated plots in both the planted and ratoon crops of sugarcane.

Information on the exact quantity of phosphorus and sulphur rendered available to crops from the applied manures is scanty, and such precise information could be obtained only with the aid of tracer techniques.

Against this backdrop, the present investigation was contemplated with the following objectives:

## Objective

To study the yield, and quality of produce in groundnut consequent to the application of organic manures;

To find out the suitable organic and inorganic source combination to increase the yield and quality parameters of ground nut.

## Materials and Methods

### Pot culture experiment:

The experimental soil is yellowish red, very deep, fine loamy, non-calcareous, and well drained. The bulk soil collected was air-dried in shade, gently pounded with a wooden mallet and sieved to pass through a 2mm sieve. Processed soil samples were filled in earthen pots at 8 kg soil per pot. There were six treatments and three replications, making a total of 18 pots.

$T_1$: Control
$T_2$: 100% of recommended dose of fertilizers (RDF) as poultry manure (PM)
$T_3$: 75% of RDF as PM + 25% as inorganic
$T_4$: 50% of RDF as PM + 50% as inorganic
$T_5$: 25% of RDF as PM + 75% as inorganic
$T_6$: 100% of RDF as inorganic

### Sowing of crops

To all pots common basal applications of 17 kg N $ha^{-1}$ as urea, 54 kg $K_2O$ $ha^{-1}$ as muriate of potash and 93.1 kg Ca $ha^{-1}$ as $CaCl_2$ were given. Single super phosphate (SSP) and elemental sulphur (S) chosen as reference source of Chemical fertilizer and poultry manure as reference organic source. Single super phosphate(SSP) applied @ 34 kg $P_2O_5$ $ha^{-1}$ and elemental S applied @ 75 kg S $ha^{-1}$ to all on equivalent P and S basis (0.054 g P per pot and 0.27 g S per pot), respectively. Seeds of groundnut five per pot were sown in each pot. After the germination, the plants were thinned to 3 per pot. Routine cultural practices were followed in raising the crop

## Pod yield

Groundnut was grown to maturity and harvested. Pods from each pot were weighed and total yield was expressed in kg $ha^{-1}$.

## Oil content

The oil content in the kernels was determined by Soxhlet extraction using petroleum ether (Boiling point 40 – 60 °C) as solvent as per the standard AOAC procedure (Horowitz, 1984). Five grams of kernels were extracted with petroleum ether in a Soxhlet apparatus for five hours and then the solvent was distilled off at 60 °C. The oil content was calculated from the weight of oil and weight of kernels and reported as percentage.

## Protein content

Protein content of kernel was estimated by multiplying nitrogen content (%) of kernel with 6.25.

**Table 1:**
**Methods of analysis of plant samples**

| Analyte | Procedure | Reference |
|---|---|---|
| Oil content | standard AOAC procedure | Horowitz, 1984 |
| Nitrogen content | Micro Kjeldahl method | Jackson (1973) |

# Results and Discussion

## Yield of groundnut

The pod yield data revealed that the highest pot yield was for integrating 25 % poultry manure with 75% chemical fertilizer, with a significant yield improvement over control. All the treatments were significantly superior to control. The second best pod yield was due to 75% poultry manure with 25% chemical fertilizer and was comparable with the treatment combining 50% poultry manure with 50% chemical fertilizer.

**Table 2:**
**Effect of poultry manure and chemical fertilizer on the pod yield of groundnut**

| Treatments | Pod yield (g $pot^{-1}$) |
|---|---|
| Control | 28.43 $^{e}$ |
| 100% PM | 38.07 $^{c}$ |
| 75 % PM + 25% CF | 41.03 $^{b}$ |
| 50 % PM + 50 % CF | 40.33 $^{b}$ |
| 25 % PM + 75% CF | 45.50 $^{a}$ |
| 100 % CF | 29.77 $^{d}$ |
| **CD (P = 0.05)** | **1.29** |

Application of phosphorus and sulphur through different sources promoted the number of pods, pod weight and shelling percentage over control. This is in agreement with the results obtained by Maity and Gajendra Giri (2003) who reported that there was a significant positive interaction of phosphorus and sulphur on pod yield of groundnut with the combined application of phosphorus and sulphur. It could be attributed to the complimentary role played by the nutrients in successful growth and development of groundnut.

Combining poultry manure with chemical fertilizer significantly influenced the dry matter yield. Enhanced dry matter accumulation might be due to the integrated effects of poultry manure and chemical fertilizer in improving the major and micronutrients availability, as well as improving soil physical, chemical and biological properties (Dwivedi *et al.,* 1990). Besides this, the dry matter yield might also have been increased due to the interaction effect of phosphorus and sulphur. Randhawa and Arora (2000) had earlier confirmed the positive interaction effect of phosphorus and sulphur on dry matter production of wheat.

When phosphorus was combined with sulphur, the yield was significantly higher than control. This might be due to the synergistic effect of phosphorus and sulphur applications on the yield and could be attributed to the enhanced root activities and root nodulation of plants leading to higher uptake of nutrients in soybean – wheat- moong sequence (Balanagoudar *et al.*, 1999).

The yield data in this present investigation revealed that the highest yield and yield attributes was for the treatment integrating 25% poultry manure with 75% chemical fertilizer. The increase in yield might also be attributed to the beneficial effects of combined use of poultry manure with fertilizers as nutrient availability increased through enhanced microbial activity, conversion from unavailable to available forms and also due to improved physical, chemical and bio-chemical conditions. These results are in conformity with the findings of Babhulkar *et al.* (2000) in soybean.

When poultry manure was combined with chemical fertilizer, the pod yield of groundnut was increased significantly as compared to sole application of either poultry manure or superphosphate. This might probably because of the increased release of the macro- and micronutrients in soil resulting in better extraction of nutrients by the crop.

Well-developed pods with fully filled kernels are essential for increasing shelling percentage. Application of phosphorus and sulphur favored higher shelling percentage. This might be attributed for a favorable peg formation and pod development with well filled kernels resulting in increased shelling percentage. Patel and Patel (1987) observed significance on shelling percentage due to application of phosphorus in groundnut.

## Quality of groundnut

### *Oil content*

The results (Table 3) of the present investigation indicated that the oil content of groundnut was significantly higher due to the application of phosphorus and sulphur. The beneficial effect of phosphorus and sulphur on oil content is due to the increase in linoleic acid content and probably due to the increase glucosides, which, on hydrolysis, produced higher amount of oil. Phosphorus and sulphur applications accelerated the metabolic pathway of linoleic acid synthesis. The beneficial effect of phosphorus and sulphur application on oil content has also been reported by Chaubey *et al.* (1992) in linseed.

Combining poultry manure with chemical fertilizers significantly influenced the oil content than sole application. In this investigation 25% poultry manure with 75% chemical fertilizer exhibited a considerable increase in oil content (45.20%). Poultry manure is a rich source of all nutrients. Dosani *et al.* (1999) have confirmed the possibility of substituting recommended dose of fertilizers by 3 t $ha^{-1}$ poultry manure in groundnut. When poultry manure is combined with chemical fertilizer this might increase the availability of nutrients. In addition to nitrogen, phosphorus and sulphur other secondary and micronutrients also required for oil production which might have been rendered available (Hegde, 2000).

**Table 3:**
**Effect of poultry manure and chemical fertilizer on quality of groundnut**

| Phosphorus and sulphur sources | Oil content (%) | Protein content (%) |
|---|---|---|
| Control | 31.30[e] | 6.26 [d] |
| 100% PM | 42.53[bc] | 10.60 [b] |
| 75 % PM + 25% CF | 43.50[b] | 12.50 [a] |
| 50 % PM + 50 % CF | 41.57[c] | 10.46 [b] |
| 25 % PM + 75% CF | 45.20[a] | 10.75 [b] |
| 100 % CF | 39.73[d] | 10.04 [c] |
| **CD (P = 0.05)** | 1.32 | 0.29 |

### *Protein content*

Phosphorus and sulphur applications significantly increased the kernel protein content (Tab 3). Maximum protein content was recorded in the treatment combining 75% poultry manure with 25% chemical fertilizer (12.50%). This was followed by 25%

poultry manure with 75% chemical fertilizer treatment (10.75%) which in turn was on par with the treatment that received poultry manure alone (10.60%) and the treatment that received 50% poultry manure combined with 50% chemical fertilizer (10.46%). The treatment of chemical fertilizer alone recorded the lowest protein content (10.04%) but this was significantly higher than in control (6.26%).

The results with respect to protein content showed a significant influence due to the applied phosphorus and sulphur. This might be due to the increased uptake of nitrogen, which in turn might be incorporated in the protein molecule. Maragatham and Chellamuthu (2000) reported that increased dose of nitrogen, phosphorus and sulphur had positive and significant influence on seed yield and protein content of sunflower.

Combined effect of phosphorus and sulphur might have stimulated the proliferation roots and thereby enhanced the absorption of nitrogen which might have contributed for the increased protein content in seed. These results corroborated with the findings of Yadav and Harishankar (1980) in sunflower.

## Conclusion

Combining poultry manure with chemical fertilizer significantly increased the pod yield, protein and oil content of kernel. In this investigation 25% poultry manure with 75% chemical fertilizer exhibited highest pod yield and considerable increase in oil content (45.20%). Maximum protein content was recorded in the treatment combining 75% poultry manure with 25% chemical fertilizer (12.50%).

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