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# Enhance the nutritional quality, yield, nutrients status of pea (*Pisum sativum* L) and soil under integrated nutrient management

**Rajiv Kumar Singh, Uttam Kumar Tripathi, Aradhana Varma, Veena Pani Srivastava and Kamlesh Ahirwar**

**Abstract**
A field experiment was conducted during (2002 to 2005) at IIVR, Varanasi, to find out the effect of recommended dose of nitrogen, phosphorus potash with pressmud on vegetable pea. Result indicated that Azad P-1 variety produced significantly higher yield and nutrient balance refers in soil compared to Azad P-3 variety during trials. While biochemical constituents of pea seeds viz, protein, vitamin C, reducing sugar and carbohydrate (23.6%, 26.9 mg/100gm, 3.1% and 55.0%) was found significantly higher in Azad P-3 compared to Arkel and Azad P-1.The recommended dose of $N_{30}P_{60}K_{80}$ kg/ha with pressmud @ 2t/ha caused marked increased in yield and yield attributes and biochemical constituents viz protein, reducing sugar carbohydrate and nutrient contents in grain i.e. N, P and S were 25.5%, 3.9%, 57% 4.0, 0.69 and 0.45% respectively and nutrient balance in soil was found significantly higher under its combination. Whenever more content of Vitamin "C" 31.6 mg/100gm under zero level nitrogen and recommended dose of phosphorus and potash along with pressmud @ 2t/ha. This combinations ($N_{30}P_{60}K_{80}$ kg/ha + pressmud @ 2t/ha) markedly improved nutrient balance in soil, seed yield as well as biochemical constituents and nutritional value in vegetable pea.

**Keywords:** Nutritional quality, Yield, Nutrient uptake and nutrient balance

## Introduction
Over the years due to intensification of Agriculture coupled with higher productivity, wide spread deficiency of nutrient in cropping up. This means those nutrients taken out of the soils are not being replenished. The result is decline in crop response of fertilizer due to sub optional and imbalance use of fertilizers application and less use of organic manure. It's due to reduce the nutritional quality and change in soil quality under any intensified monotomy cropping system (Dhyani *et.al.* 2007). Under such situation integrated nutrient management reverse the ill effect of soil and promote the supply of nutrient as per required of crop for enhance the nutritional quality and yield of crop for more profit in forth coming time. Because Synergistic effect of organic and inorganic combination may be on the supply of macro and micro nutrients due to improvement in the nutritional quality and physical & biological health of soil, water and nutrient holding capacity and aeration (Acharya, 2002 and Baskar, 2003) [1, 3]. In that case microbial decomposition and supply of latent energy brought about the transformation of inorganic nutrients held in soil colloid to readily utilized form for growing plant, its due to significantly lead to higher Vitamin, protein, reducing sugar carbohydrate and N, P, S and Fe that corroborates with the finding (Bhattari *et al*., 2003, Laxminaryana and Patiram 2005) [4, 9]. The objective of the present study is to investigate the change in quality parameters, nutrient contents and nutrient balance in soil through vegetable pea under integrated nutrient management.

## Materials and Methods
A field experiment was conducted to evaluate the impact of organic and inorganic combination on yield and biochemical constituents of vegetable pea seeds at Indian Institute of Vegetable Research, Varanasi (U.P). The soil of the experimental site was sandy loam with pH 7.6, available $N_{270}$ kg/ha, $P_2O_5$ $_{18}$ kg/ha $K_2O$ $_{180}$ kg/ha sulphur 10 kg/ha, organic carbon 0.38%.There were six treatments viz To, control $T_1$, $N_{30}$,$P_{60}$,$K_{80}$ kg/ha $T_2$, Pressmud@ 2t/ha.$T_3$, $N_{30}$,$P_{60}$, $K_{80}$ kg/ha+ pressmud @ 2t/ha,$T_4$, $N_0$, $P_{60}$, $K_{80}$ kg/ha + Pressmud @ 2t/ha.$T_5$,FYM @ 5t/ha replicated three times in Split Plot Design with 5 $m^2$ plot size. And the crop was sown in the last week of October during the trials. Nitrogen, Phosphorus and Potash were applied at the time of sowing, FYM and pressmud were applied at the time of field preparation.

Recommended agronomic practices and plant protection measures were followed as per recommondation. The crop was irrigated at active growth stages and at pod initiation stage.

The crop was harvested and grain and straw yields of each treatment were recorded separately. Harvested grain and straw samples were taken and dried at 75 ºC 48 hours then after grind sample passed through a 2mm sieve and mixed thoroughly and used for biochemical analysis. The Nitrogen content in seed estimated by (modified Kjedahl, Jackson 1967) and percentage of protein was calculated multiplying the nitrogen percentage by a factor 6.25. AOAC (1990) [2]. The concentration of nitrogen, phosphorus and sulphur in grain and straw was determined by using standard procedure The uptake of nutrient kg/ha (nitrogen, phosphorus and sulphur) was calculated by concentration of nutrient in grains multiplied by yield (q/ha).The ascorbic acid, reducing sugar and carbohydrate determined by volumetric, Dinitrosalicylic acid and phenol sulphur acid method respectively according to Sadasivam and Manickam (1996) [14]. Estimation of phosphorus, sulphur, iron in grain and straw was made by Jackson (1967) the soil samples were also collected after final picking to determine the change in soil organic carbon, pH and available N, P and S as per the methods described by Walkely and Block (1946) [19] Subbiah and Asija (1956) [16], Olsen *et. al*. (1954) [13]. Nutrient requirement (kg/q), soil efficiency (percent) and nutrient balance was calculated by nutrient uptake (kg/ha) divided by yield q/ha, nutrient uptake (kg/ha) divided by soil test value (kg/ha) multiplied by hundred and available nutrient in soil after crop harvest minus available nutrient in soil pre sown corp according Kanwar and Katyal (1997) [8].

**Yield attributes**

The application of recommended dose of nitrogen, phosphorus, potash with pressmud @ 2 t/ha revealed that remarkably higher yield and yield attributes viz No. of pod/plant, No. of grain /pod, Pod length and grain yield (11.82 q/ha) followed by application of recommended dose of $P_{60}$, $K_{80}$ and $N_0$ with pressmud @ 2 t/ha (Table 1). During the decomposition of organic manure release of appreciable quantities of $Co_2$ play an important role in increasing the availability of phosphorus, iron, sulphur, copper and zinc soil which was ascribed to mineralize action of manure, reduction of fixation and complexing properties of this manure with micronutrients. It's due to more transformation of inorganic nutrients held on soil colloid to readily utilized by growing plant its due to plant was vigorous and more utilization of natural resource due to increase yield from cited by (Laxminaryana K and Patiram 2005) [9].

**Quality attributes**

Data showed that all treatment found significantly higher in vitamin "C"and reducing sugar, except treatment $T_1$ and $T_5$, as well as control (Table-1a). Critical examination of data showed that significantly lower value of vitamin "C "and reducing sugar was found with $T_5$ as compared to recommended dose of N P and K. Application of pressmud @ 2t/ha along with No $P_{60,}$ $K_{80}$ kg/ha registered highest vitamin "C" and reducing sugar in grain (31.6 mg/100 gm 3.9%) respectively because additional supply of sulphur and iron through presmud.This may be due to improvement in chlorophyll content more assimilation of photosynthates and more sugar metabolism according to Kanaujia *et al*., (1997) [7] followed by application of pressmud @ 2t/ha along with recommended dose of nitrogen, phosphorus, potash. However Application of pressmud @ 2t/ha along with recommended dose of nitrogen, phosphorus, potash had increased maximum protein and carbohydrate content in grain (25.9% and 57%) followed by application of pressmud @ 2t/ha along with $N_0$ $P_{60}$, $K_{80}$ kg/ha (24.9 and 56.6%). This has significant increased in protein and carbohydrate content in grain under application of organic and inorganic combination as compared to other treatments combination. The application of pressmud is good source of major and micronutrients. In presence of organic matter there is better absorption and utilization of nutrients by plant. Therefore increase in the percentage of plant nitrogen and uptake of nitrogen from soil consequently increased protein content in grain. Micronutrient plays a vital role in enzymatic activity involved in all the major metabolic process of plant such as synthesis of carbohydrate organic acid and vitamins similar observation was reported by Sharma *et al.,* (2002) [15].

**Genotypic**

Maximum yield and yield attributes was recorded in Azad P-1 compared to Azad P-3 and Arkel (Table-1) and highest reducing sugar, carbohydrate and protein content in grain were found in Azad P-3(3.1, 55 and 23.6%) respectively compared to Arkel and AzadP-1.while vitamin c is registered highest in Azad P-1(26.7 mg/100g) compared to Azad P-3 and Arkel.

**Nutrient content and uptake in grain and straw**

A Critical analysis of data showed that highest nitrogen, phosphorus, sulphur and iron percentage in grain and straw were found under the application of pressmud @ 2 t/ha along with recommended dose of nitrogen, phosphorus and potash, followed by application of pressmud @ 2 t/ha along with No $P_{60}K_{80}$ kg/ha (Table 2). Synergistic effect of organic and inorganic combination may be supply of organic acids and macro & micro nutrient due to improvement in the physical and biological health of soil therefore more water and nutrient holding capacity and good aeration in soil accorded by (Acharya, 2002 and Baskar, 2003) [1, 3]. In that case microbial decomposition and supply of latent energy brought about the transformation of inorganic nutrients held in soil colloid to readily utilized form for growing plant, its due to significantly lead to higher N, P, S and Fe that corroborates with the finding (Bhattari *et al*., 2003, Laxminaryana and Patiram 2005) [4, 9].

**Genotypic**

Maximum phosphorus, nitrogen, sulphur and iron content in grain and straw and uptake of its nutrient were found in Azad P-1(0.47 &0.6, 2.5 &3.78,0.38 &0.37 and 0.05 &0.06) and uptake its nutrients (6.2 kg/ha, 41.3 kg/ha, 3.8 kg/ha and 0.66 kg/ha) respectively compared to Arkel and Azad P-3 (table-2). This variety is good perform in all above mentioned character in similar condition due to better utilization of given or natural resources through more fibrous roots and biomass(leaf size, No. of branches/plant stem diameter) was noticed under this variety and late maturity nature compared to Azad P-3 and Arkel similar observation was reported by De Nirmal *et.al* (2007) [12].

**Nutrient requirement and soil efficiency**

Application of pressmud with recommended dose of NPK registered highest nutrient requirement of nitrogen 4.4 kg/q (Table-2) and soil efficiency of N, P and S (16.6, 33.2 and 33.1%) respectively followed by application of recommended dose of P, K and No (Figure1a). The highest nutrient requirement of phosphorus and sulphur (0.64 and 0.39 kg/q) was noted under the application of recommended dose of phosphorus, potash and nitrogen level zero with pressmud @ 2 t/ha. Because synergistic effect of P and S on each other. Its due increased in the availability of phosphorus and sulphur in pea rhizospher. And secretion of root exudates to ionic equilibrate, organic acids to release phosphorus and sulphur from non exchangeable pool to labile and makes available which was supporting the finding Masto *et al*., (2004) [10].

**Nutrient status (mean data) of cultivated pea variety soil before and after the crop**

The effect of treatments on genotypic variability among the three pea cultivars on the quality status irrespective of treatment was presented in (Table 1). No significant differences among three pea cultivars for Vitamin C, nutrient requirement (kg/q), carbohydrate in grain and phosphorus, iron content in grain and straw was recorded. While reducing sugar content in grain was recorded significantly higher in Arkel and Azad P-3 compared to Azad P-1. Whenever significantly higher nitrogen, sulphur content in grain and straw, and yield in Azad P-1 followed by Azad P-3 (Table 2). The nutrient status of the experimental soil sample was more found in Azad P-1 compared to other tested cultivars analyzed before the sowing and after the harvest of the crop (*Figure 3b*). A positive balance of nitrogen to the tune 14 to 20 kg/ha, balancing of sulphur -0.3 to 1.8 kg/ha, and marginal positive balance 4.2 to 5.1 kg/ha in phosphorus (*Figure 2b*) and soil efficiency of these nutrient was recorded in Azad P-1, followed by Azad P-3 and Arkel (*Figure 1b*).

**Soil organic carbon, pH and available nutrients**

The effect of $N_{30}$, $P_{60}$ and $K_{80}$ kg/ha on soil organic carbon and pH was found no significant (*Figure 3a*). However, its content in soil increased with additional supply of pressmud along with recommended dose of nitrogen, phosphorus and potash as compared the control. The difference among treatments were non significant in nitrogen, phosphorus, potash fertilizers without pressmud. Whenever improvement was also observed in these parameters due to application of pressmud alone and in the presence of nitrogen, phosphorus, potash fertilizers compared to control. Pressmud improved the status of the soil available nitrogen, phosphorus, and potash due to increased activity of nitrogen fixing bacteria there by resulting in higher accumulation of nitrogen in soil, besides additional supply of nitrogen to the soil (Miller *et al*., 1987) [11]. Whenever phosphorus status of soil increased with increasing levels of phosphorus due to lower utilization of phosphorus by crops resulting in building of soil phosphorus status (Tolonur and Badonur 2003) [17]. So increase phosphorus and sulphur content of soil treated with pressmud with recommended dose of nitrogen, phosphorus, potash due to release of appreciable quantities of organic acid and $Co_2$ during decomposition of organic manure whose oxidation may contributes to $H^+$ ion production(*Figure 3a*).These ions containing and reduce the alkalinity or acidification. It's due to solubilazation of unsoluble phosphorus and sulphur similar observation was also reported by Acharya *et al*., (2002) [1] Baskar K (2003) [3] and Venkatesh *et al*., (2002) [18].

**Table 1:** Enhance the nutritional quality and yield of pea under integrated nutrient management.

| Treatment | No. of pod/plant | $F_{PW}$ (g) | $D_{PW}$ (g) | Pod length (cm) | No. of grain/pod | $G_Y$ (q/ha) | $F_{PY}$ (q/ha) | Vit. C (mg/100gm) | Reducing sugar grain (%) | Carbohydrate (%) grain | Protein in grain (%) | Increasing% yield |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $T_o$ | 7.6 | 33.3 | 7.2 | 8.2 | 5.1 | 6.52 | 48.3 | 24 | 2.3 | 47.7 | 21.9 | |
| $T_1$ | 7.6 | 43.5 | 9.7 | 9.2 | 6.4 | 9.870 | 68.7 | 23.1 | 2.7 | 47.8 | 22.4 | 50.7 |
| $T_2$ | 9.0 | 39.6 | 8.3 | 8.4 | 5.6 | 7.88 | 52.7 | 27.0 | 3.3 | 51.2 | 22.5 | 21.2 |
| $T_3$ | 12.4 | 61.9 | 15.0 | 9.9 | 8.0 | 11.82 | 100.2 | 31.6 | 3.9 | 57.0 | 25.5 | 81.5 |
| $T_4$ | 10.9 | 57.1 | 13.9 | 9.7 | 6.7 | 11.48 | 99.3 | 30.6 | 3.0 | 56.6 | 24.9 | 76.6 |
| $T_5$ | 8.8 | 37.9 | 9.1 | 8.8 | 5.6 | 7.34 | 54.7 | 21.3 | 2.5 | 52.0 | 22.4 | 12.3 |
| $LSD_{0.05}$ | 2.5 | 8.3 | 1.5 | 0.5 | 1.0 | 0.94 | 6.1 | 0.97 | 0.2 | 2.4 | 0.7 | |
| Genotype | | | | | | | | | | | | |
| Arkel | 10.6 | 44.1 | 70.1 | 8.8 | 5.0 | 7.64 | 62.6 | 26.5 | 3.1 | 54.1 | 23.2 | |
| Azad P-1 | 9.4 | 45.3 | 10.5 | 9.2 | 7.3 | 11.13 | 81.4 | 26.9 | 2.8 | 52.8 | 23.0 | 46.4 |
| Azad P-3 | 8.1 | 47.3 | 11.0 | 9.1 | 6.4 | 8.67 | 68.2 | 26.7 | 3.1 | 55.0 | 23.6 | 14.07 |
| LSD = 0.05 | 2.7 | 8.1 | 2.0 | 0.9 | 1.0 | 0.57 | 5.9 | 0.9 | 2.7 | 0.5 | 0.01 | |

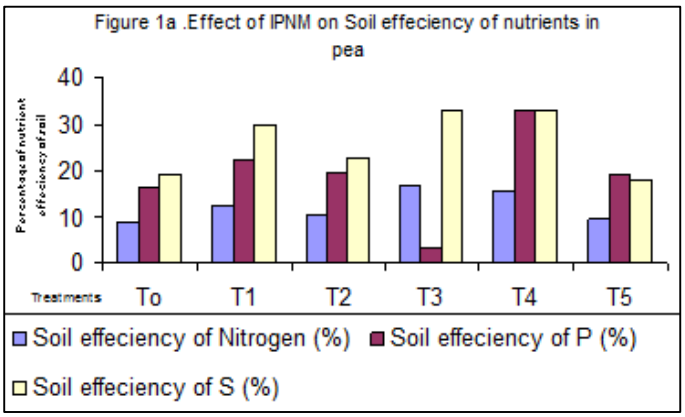
Fpw-Fresh pod weight, Dpw-Dry pod weight, Gy-Grain yield and Fpy- Fresh pod yield

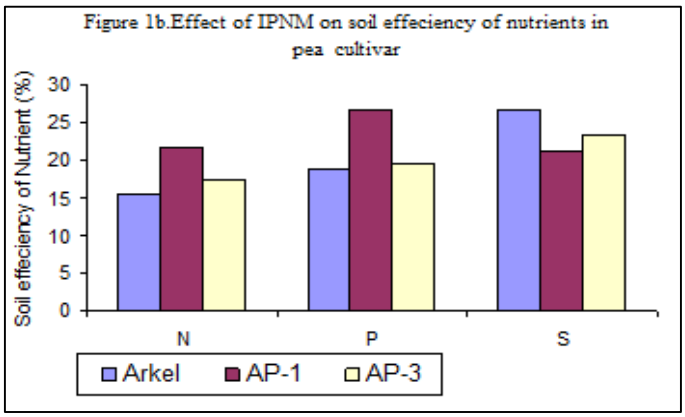
**Table 2:** Enhance the nutrient content and uptake of pea under integrated nutrient management

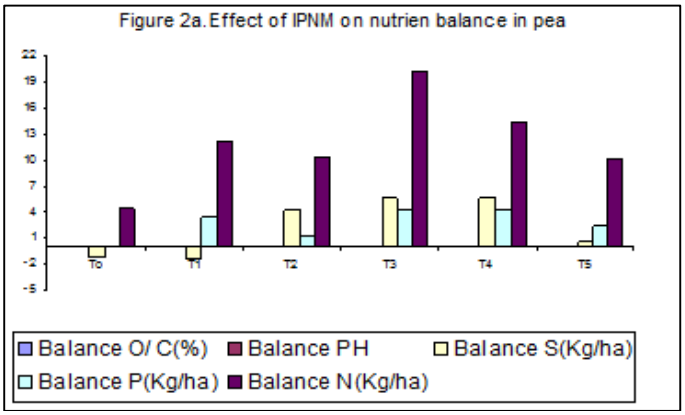
| Treatment | Phosphorus (%) | | Nitrogen (%) | | Sulphur (%) | | Iron (%) | | Uptake of P by grain (kg/ha) | Uptake of N by grain (kg/ha) | Uptake of S by grain (kg/ha) | Uptake of Fe by grain (kg/ha0 | Nutrient requirement in ( kg/quintal) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Straw | Grain | Straw | Grain | Straw | Grain | Straw | Grain | | | | | N | P | S |
| $T_o$ | 0.32 | 0.47 | 2.3 | 3.5 | 0.25 | 0.24 | 0.04 | 0.03 | 3.0 | 22.9 | 1.7 | 0.19 | 3.5 | 0.46 | 0.26 |
| $T_1$ | 0.36 | 0.51 | 2.5 | 3.6 | 0.30 | 0.27 | 0.06 | 0.05 | 4.8 | 35.7 | 2.6 | 0.49 | 3.6 | 0.48 | 0.26 |
| $T_2$ | 0.41 | 0.51 | 2.4 | 3.6 | 0.43 | 0.38 | 0.07 | 0.06 | 3.8 | 28.3 | 2.8 | 0.47 | 3.5 | 0.48 | 0.35 |
| $T_3$ | 0.56 | 0.69 | 2.9 | 4.04 | 0.47 | 0.45 | 0.07 | 0.06 | 7.4 | 47.7 | 4.5 | 0.71 | 4.4 | 0.62 | 0.38 |
| $T_4$ | 0.57 | 0.69 | 2.8 | 4.0 | 0.46 | 0.44 | 0.05 | 0.03 | 7.3 | 45.6 | 4.5 | 0.34 | 3.9 | 0.64 | 0.39 |
| $T_5$ | 0.42 | 0.55 | 2.5 | 3.6 | 0.28 | 0.26 | 0.04 | 0.03 | 3.9 | 26.1 | 1.9 | 0.22 | 3.5 | 0.53 | 0.25 |
| $LSD_{0.05}$ | 0.06 | 0.05 | 0.07 | 0.08 | 0.01 | 0.02 | 0.02 | 0.02 | 0.6 | 3.7 | 0.21 | 0.04 | | | |
| Genotype | | | | | | | | | | | | | | | |

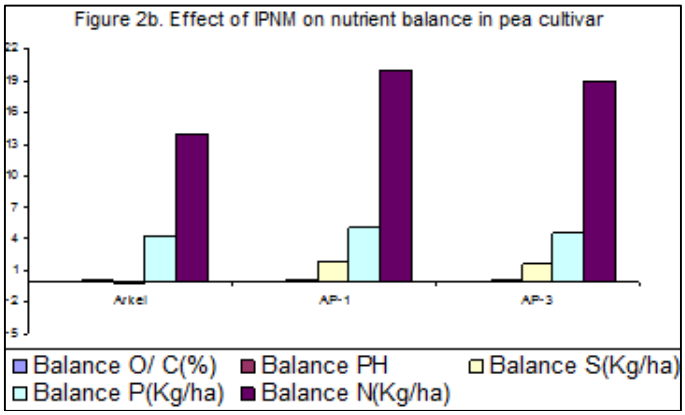
| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Arkel | 0.43 | 0.57 | 2.5 | 3.71 | 0.37 | 0.34 | 0.04 | 0.05 | 4.4 | 28.8 | 2.6 | 0.38 | 3.7 | 0.57 | 0.34 |
| Azad P-1 | 0.47 | 0.60 | 2.5 | 3.78 | 0.39 | 0.37 | 0.05 | 0.06 | 6.2 | 41.3 | 3.8 | 0.66 | 3.72 | 0.56 | 0.34 |
| Azad P-3 | 0.42 | 0.55 | 2.5 | 3.68 | 0.35 | 0.32 | 0.04 | 0.06 | 4.5 | 33.1 | 2.7 | 0.52 | 3.8 | 0.51 | 0.31 |
| LSD = 0.05 | 0.06 | 0.07 | 0.06 | 0.08 | 0.009 | 0.009 | 0.01 | 0.01 | 0.8 | 2.3 | 0.21 | 0.045 | | | |

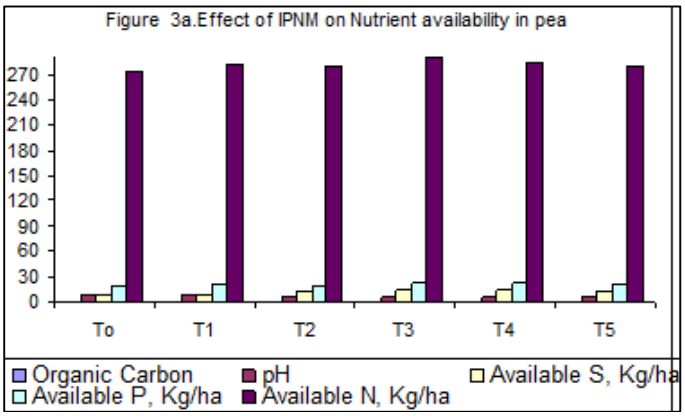
P-Phosphorus, N-Nitrogen, S-Sulphur, Fe-Iron

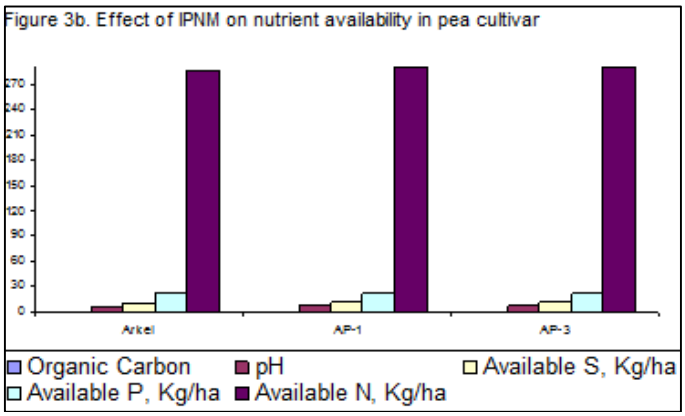
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