CHAPTER VI

DISCUSSION
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The results obtained in the experiment entitled "Integrated Nutrient Management in Groundnut–Field Pea–Summer Groundnut sequence under semi-arid conditions of central U.P." have been discussed in this chapter in terms of cause and effect relationship and attempt has been made to discuss the meaningful and relevant results keeping in view the objectives set for the study and the research evidences available on the subject.

Environment plays an important and vital role in determining the productivity of crops. Under optimum climate condition the crops produce maximum yield and with variations in climatic conditions the crop yield is affected accordingly. The rainfall, maximum and minimum temperature, relative humidity, wind velocity during the crop durations of the sequence, groundnut – field pea – summer groundnut in two years of investigations have been presented in Table 3.1.

The experiment was conducted on sandy loam soil containing 0.33 per cent organic carbon, 10.0 kg available P per hectare and 269.00 kg available K per hectare initially i.e., before starting the experiment. The same layout plan allocating twelve fertility treatments randomly was used for all three crops in both the years. As envisaged earlier all twelve treatments were given to kharif groundnut while in the following seasons, peas and groundnut (summer) crops the application of FYM in concerning treatments was with-held to study the residual effect of the manure in peas and summer groundnut crops. In next year also the lay-out plan remained as such for cumulative effect of treatments.
The detrimental effect of fertilizer nutrients imbalance are undoubtedly most serious with nitrogen since it greatly stimulates crop growth and accompanying plant nutrients uptake of P. The excessive use of nitrogen alone is avoided as mostly it depletes soil phosphorus fertility for legume and leguminous oil seeds (Groundnut). The main nutrients from fertilizer management point of view are phosphorus, sulphur, calcium, Potassium, zinc etc. As the crop meets a larger part of nitrogen through biological nitrogen fixation. Nitrogen and phosphorus sometimes interact synergistically in enhancing the yield of some crops, however in legumes because of biological nitrogen fixation such effects are not usually observed. For sustenance of higher crop yields, supplementation of K along with nitrogen and phosphorus is essential only exception of soils very high of potassium. For sustaining high yields, balance fertilizer use is a must but at the same time cost effectiveness of the fertilizers has to be kept in mind. The NPK use ratio in Uttar Pradesh is not enough against the recommended ratios for crops by State Department of Agriculture. Highly intensive cropping sequences require still high level of manuring to avoid the further depletion of nutrients in soils and to avoid negative nutrient balance.

Legumes have special preference to phosphatic fertilizers. The phosphorus availability to plants is considerably increased by action of soil organisms which dephosphorylate phosphorus bearing in organic compounds and also by bringing about favorable changes in soil reaction in soil micro-environment leading to solubilization of inorganic phosphate sources. They also reduce inorganic phosphate fixation to a
remarkable degree and thus increasing its availability indirectly. To achieve this, it is imperative that efficient organism adopted to local condition should be isolated and congenial conditions created by modifying hostile soil environment, if any. There is also need to identify areas and crops for which such artificial inoculations and likely to be more successful.

In the present experimental phosphatic solubilizing bacteria was used in groundnut grown in kharif season and also in summer season to identify its efficiency in different environments. Further it’s use with direct application of FYM in kharif season in summer groundnut, in condition of residual FYM was made to select proper soil environments with varying organic matter content. More-so-ever its efficacy was also tested on pea crop grown between mean two groundnut crops but with no use of FYM. Pea happens to be grown in winter season which provides a different environment to PSB for their activities.

Sulphur has become the fourth deficient element in Indian oils. Sulphur requirement of legumes and oil-seeds in high because it is involved in formation of enzymes and metallo-proteins, such as iron sulphur proteins. It is an integral part of some essential amino-acids. It is also constituent of Glutathione needs for respiration and synthesis of essential oils. It is also involved in carbohydrates metabolism of crop/plants.

Keeping the above facts in view the treatments were composed. The NPK on recommended doses (RDF), the addition of farm yard manure, phosphate solubilizing bacteria and sulphur were used in
formation of different treatments which were compared to the normal farmers practice of 50 kg DAP (T₂) to crops of groundnut and peas and with control.

The results presented in the preceding chapter indicate that pod yield of groundnut grown in kharif season increased considerably with the application of RDF (20 N + 30 P₂O₅ + 45 K₂O kg/ha) + 30 q FYM + PSB (T₁₁) in both the years of study though it did not vary significantly from the treatments viz., T₁₀, T₆ and T₁₂ in both years. Further the pooled data of two years also showed the significant increase in pod yield with T₁₁ which of course was statistically at par with T₁₀ and T₆. There was 20.63 per cent increase in pod yield in T₁₁ over T₂ (Farmers practice of 50 kg DAP only). The increase in pod yield with T₁₁ may be attributed to significant increase in weight of 100-kernels, dry weight of pods per plant, number of pods per plant, weight of kernels per plant and also the growth of plants measured in terms of fresh and dry weight of foliage, number of branches and number of functioning leaves where the supremacy of T₁₁ was maintained though T₁₁ was found statistically at par with T₆, T₁₀, T₁₂ in number of branches and fresh and dry weight of foliage in pooled results and also in separate years of study. Improvement in all these parameters accompanied with higher total uptake of nitrogen and total uptake of sulphur with T₁₁ treatments which respectively showed increments of 26.59 per cent and 26.57 per cent over T₂ (Farmers practice). The results in conformity with findings of Pawar and singh (2003), Rao and Shatawat (2003) and Singh (2007) in order to assess the nutrient requirements of kharif groundnut in view of foregoing the discussion, it is apparent that the application of 20 N + 30
P₂O₅ + 45 K₂O kg/ha (RDF) + 30 quintals FYM + 2 kg PSB (Phosphate Solubilizing Bacteria) is most effective for maximization of groundnut yield.

Pea crop was raised after kharif groundnut in succession on the same layout plan of the groundnut with the same 12 treatments except that the use of FYM was withheld for its study in respect of residual effect. The experimental crop of dwarf field pea variety sapana received 73.43 mm and 35.00 mm rains during first and second year respectively. Other weather parameters viz., maximum and minimum temperatures, relative humidity and wind velocity during crop periods remained all most similar during both years of experimentation. As the experimental crop was grown with irrigations, the effect of diversity of rainfall and intensity could not affect the treatmental effects due to no scarcity of water.

The inclusion of PSB treatments was though necessary to ascertain the bacterial activity in relatively low temperature condition in winter season also. Further sulphur need of pea crop was to ascertain because of its role in protein synthesis.

Excessive amount of nitrogen to legume is harmful as it produces succulency in plants which enhances their sensitivity to stress of water and temperature. Phosphorus has a vital role in break down of the carbohydrates and other food produced by photosynthesis in the plant. An absence of phosphorus would prohibit photosynthesis and limits the plant capability to produce carbohydrates such as sugar, starch and cellulose.
Potassium is one of the three major nutrients for crop production. The use of fertilizer potassium is lower than nitrogen and phosphorus due to high content of K in our soils. Pulse crops have been found to respond to moderate application of potash and evidences indicate that the crop yields tended to stabilize at fairly high levels under N, P, K. With the above reason the recommended doses of fertilizer (RDF) for 20, 60 and 40 kg/ha, N, P₂O₅ and K₂O was included.

In order to adjudge the relative performance of different treatments applied to pea crop. The forthcoming results revealed that seed yield of pea was significantly higher in T₁₁ (RDF + 30 q FYM + PSB) than all other treatments in both the years except T₆ (RDF + 30 q FYM) and T₁₀ (RDF + 30 q FYM) but in pooled result T₁₁ maximized the yield through it was not significantly different from T₆ (RDF + 2.30 q FYM). T₁₁ gave 58.58 per cent more yield than farmers practice (T₂). There had been considerable increase in weight of 100 seeds, weight of seed per plant, number of seeds per plant, dry weight of seeds per plant, number of pods per plant and dry weight of pods per plant with T₁₁ over all other treatments that contributed to increase the seed yield (q/ha) in different years and in pooled results of two years. The treatment T₆ (RDF + 30 q FYM) in pooled yield and treatment T₆ and T₉ (RDF + 10 q FYM + PSB) were found statistically at par with T₁₁ in first and second year respectively. The total uptake of nitrogen was significantly the highest T₁₁ in different years and also in pooled data when 48.6 per cent higher uptake of nitrogen in T₁₁ was obtained over T₂ (Farmers practice). Along with nitrogen the sulphur uptake was also found
significantly more in $T_{11}$ than all other treatments except the treatments $T_6$ and $T_{10}$ (RDF + 20 q FYM + PSB) in different years and in pooled data. The higher uptake of aforesaid nutrients in $T_{11}$ lead to significant increase in number of branches per plant and fresh and dry weights of foliage per plant. The percentage increments in number of branches fresh weight of foliage per plant and dry weight of foliage per plant in $T_{11}$ were 20.6, 9.10 and 9.27 per cent over the treatment $T_2$ (Farmer practice) respectively. The residual effect of applied farm yard manure (FYM) to preceding groundnut crop was conspicuous while comparing treatments $T_6$ (RDF + 30 q FYM) and $T_3$ (RDF) in seed yield of different years and also in their pooled result. As a consequence of it, the seed yield was maximum in $T_{11}$ having been combined with the use of PSB culture. Such residual effect of FYM was also noticed in all other yield attributes of peas viz. weight of 100 seeds, weight of seeds per plant, number of seeds per pod, dry weight of pods per plant, number of pods per plant etc. These results confirm the finding of Singh (2000).

Summer groundnut was the last crop of the cropping sequence groundnut – field pea – summer groundnut. Like peas in winter, the summer groundnut crop was grown on same layout plan with same allocation of treatments in situ. The same treatments of kharif groundnut were included except that no direct application of FYM was done in FYM containing treatments for the purpose of the residual study in summer groundnut. The groundnut variety $D_4D_8$-10 of 85–90 day duration also happen to be the same as for kharif groundnut. The crop was planted on $15^{th}$ March during zaid season. The maximum and
minimum temperatures went on increasing with the advancement of the crop, the relative humidity was low in the beginning which continued for long time in the season. The crop had to be irrigated several times to meet the water requirement in this season of the both the years. The treatments had affected the plant characters significantly. As studied in findings that $T_{11}$ (RDF + 30 q FYM + PSB) produced significantly higher pod yield than other treatments in both the years and in pooled results. Though, it did not differ significantly from $T_6$ (RDF + 30 q FYM), $T_{10}$ (RDF + 20 q FYM + PSB) and $T_{12}$ (RDF + PSB + sulphur) in first year and $T_6$ and $T_{10}$ in second year like that of the pooled results. The percentage increase in pod yield in $T_{11}$ was 24.10 over $T_2$ (Farmers practice). The considerable increase in pods yield may be attributed to weight of kernels per plant, number of kernels per pod, weight of 100-kernels, dry weight of pods per plant and number of pods per plant where $T_{11}$ mostly maintained its supremacy over other treatments in pooled and individual year results. In weight of kernels per plant, dry weight of pods per plant and number of pods per plant and weight of 100-kernels, there has been no significant difference between $T_{11}$ and $T_6$ in separate years but in characters such as number of kernels per pod, fresh and dry weight of foliage per plant, number of branches per plant and number of functioning leaves per plant $T_{11}$, $T_6$, $T_{10}$, $T_{12}$ were found at par to each other in individual years. However in pooled data $T_{11}$ excelled statistically to all other treatments in number of pods per plant, number of branches per plant and number of functioning leaves per plant in pooled results of two years. The favourable effect of $T_{11}$ in all these characters contributed to increase the pod yield ultimately. This may also due to higher total uptake of nitrogen and sulphur per hectare.
years. However there had been no significant variation among $T_{11}$, $T_6$, $T_{10}$ and $T_{12}$ in total uptake of nitrogen and sulphur in individual years and in pooled results of two years. Though the effect of single application of sulphur was not studied however its applications along with NPK and PSB combined was found of equal importance to that of $T_{11}$ in fresh weight of foliage, number of branches, number of functioning leaves per plant, number of kernels per plant and also pod yield q/ha in first year. The uptake of total nitrogen and total sulphur might have also contributed to the development of aforesaid characters and yield in separate years and pooled results of two years. There had been 24.13 per cent increase in total uptake of nitrogen and 24.10 per cent in total uptake of sulphur in $T_{11}$ over the farmers practice ($T_2$) due to which there has been considerable increase in pod yield ultimately. These results corroborated the findings of Singh (2007).

The pooled yield of two years of kharif groundnut, pod yield, seed yield of peas and pod yield of summer groundnut were 22.92, 30.23 and 25.01 (q/ha) had been the mean yields (Table 4.22).

The data for the pooled yield of two years in individual crops (Table 4.22) had indicated that the groundnut, pod yield was maximum with $T_{11}$ in crops of both the seasons though it was significantly not different from $T_{10}$ and $T_6$ the seed yield of pea in $T_{11}$ was also found maximum. The highest yield with $T_{11}$ in all three crops of sequence tended to maximize the gross income, net returns and benefit cost ratio followed by $T_{10}$ and $T_6$. These results support to the finding of Singh (2005), Singh (2006)& Singh (2007).