CHAPTER VII

SUMMARY AND CONCLUSION
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The experiment entitled “integrated nutrient management in groundnut - field pea - summer groundnut sequence under semi-arid conditions of central U.P.” was conducted for two years (2003-04, 2004-05) at the Zonal Agriculture Research Station, Mainpuri of C.S.A. Azad University of Agriculture and Technology, Kanpur.

The soil of the experimental field was sandy loam with a pH of 8.0, organic carbon 0.33 and available phosphorus and available potassium were 10.0 kg/ha and 269.0 kg/ha initially before starting the experiment. Groundnut (Arachis hypogaea L.) a crop generally grown in rainy season is severally affected by problem of water logging and disease and pest incidence. The availability of better genotype of 85 to 90 days duration D'har-86 has made it not only feasible to include in multiple cropping with irrigations but also to grow it in summer season. An early maturing dwarf leafless variety of field pea ‘Sapana’ was grown between two groundnut crops in winter season. The variety was of about 135 days duration. Initially the layout of the field experiment was done on 15\textsuperscript{th} July, 2003. The experiment was conducted in Randomized complete block design with four replications. There were twelve treatments for comparison of their comparative values in all three crops. The treatments were evaluated on growth yield attributes and yield as well as nutrients uptake (N and S) of different crops. The composition of treatments was such as to fulfil the set objectives for investigation. The treatments were T\textsubscript{1} (control), T\textsubscript{2} (farmer’s practice), T\textsubscript{3} (Recommended doses (RDF) of fertilizers for NPK), T\textsubscript{4} (RDF + 10 q
FYM/ha), T₅ (RDF + 20 q FYM/ha), T₆ (RDF + 30 q FYM/ha), T₇ PSB
(Phosphorus solubilizing bacteria) T₈ RDF + PSB, T₉ RDF + 10 q
FYM/ha + PSB, T₁₀ RDF + 20 q FYM/ha, T₁₁ RDF + 30 q FYM/ha +
PSB, T₁₂ RDF + PSB + 20 kg S/ha. These treatments were given to
rainy season groundnut crop. After the harvest of groundnut crop the
same layout plan with same treatments was followed for the succeeding
crop of pea (c.v. Sapna) in situ except that the use FYM was with-held
in FYM containing treatments for the purpose of studying residual effect
of the same applied in preceding kharif crop. Groundnut variety
D₄D₈-10 in summer was planted on 15th March after the harvest of peas
with the same applied treatments to pea crop. It was for further residual
effect of FYM in the treatments originally with applied FYM for rainy
season groundnut. The treatment of PSB (phosphate solubilizing
bacteria) culture @ 2 kg/ha applied singly or in combination with FYM
in some of the treatments of the crop rotation was aimed to enhance
phosphate availability in different crop environments. Further sulphur
application was also added to a treatment (T₁₂) with a view to as certain
its efficacy, if any. In field pea and summer groundnut crops four
irrigations had to be given to each of them. Foret 10 G was mixed in soil
before sowing of groundnut. Normal interculture operations were
provided to all crops.

The salient results obtained in experiments of groundnut, field
peas and summer groundnut in two years, study have been summarized
below.
Groundnut crop

1. Various fertility treatments did not influence significantly the plant stand after complete germination as well as at harvest of the rainy season crop of groundnut in two years separately and also in pooled result of two years.

2. The application 20 N + 30 P₂O₅ + 45 K₂O kg/ha as recommended dose of fertilizer (RDF) for groundnut alongwith 30 q FYM/ha and PSB (T₃) enhanced significantly the number of branches per plant in both years and also in pooled result though it was found statistically at par with T₃ (RDF + 10 q FYM/ha), T₁₀ (RDF + 20 q FYM/ha + PSB) and T₁₂ (RDF + PSB + 20 kg S/ha) in different years and in their pooled result.

3. The number of functioning leaves per plants were increased significantly under the effect of T₁₁ (RDF + 30 q FYM + PSB) in both the years and in pooled results, when it did not vary significantly from T₆ and T₁₀.

4. Fresh weight of foliage per plant was significantly improved under the effect of T₁₁ (RDF + 30 q FYM + PSB) in separate years and also in their pooled effect though it was statistically at par with T₅ (RDF + 20 q FYM), T₆ (RDF + 30 q FYM), T₉ (RDF + 10 q FYM + PSB), T₁₀ (RDF + 20 q FYM + PSB) and T₁₂ (RDF + PSB + 20 kg S) in pooled results. There was 12.35 percent increase in fresh weight of foliage in T₁₁ over T₂ (Farmer’s practice of application of 50 kg DAP only).
5. The improvement in dry weight of foliage was according to fresh weight of foliage where significant increase in \( T_{11} \) was noted with the exception of \( T_5, T_6, T_9, T_{10} \) and \( T_{12} \) found at par in separate years and in pooled result. There was 12.9 percent increase in dry weight of foliage with \( T_{11} \) over \( T_2 \) (Farmer’s practice) in pooled result.

6. There has been considerable increase in number of pods per plant in \( T_{11} \) over all other treatments in pooled result however, \( T_{11} \) maintaining such supremacy was statistically at par with \( T_6 \) and \( T_{12} \) in both years separately.

7. The dry weight of pods per plant was enhanced considerably in \( T_{11} \) over all other treatments in separate years and in their pooled effect. There was 48.5 percent increase in dry weight of pods/plant with \( T_{11} \) over \( T_2 \) (farmer’s practice).

8. The number of kernels per pod was found improved in \( T_{11} \) over \( T_1 \) (control), \( T_2 \) (farmer’s practice), \( T_3 \) (RDF), \( T_4 \) (RDF + 10 q FYM/ha), \( T_7 \) (PSB) in pooled result as well as in separate years result.

9. The weight of kernels increased significantly in \( T_{11} \) over all other treatments having 42.2 percent increase over \( T_2 \). \( T_{11} \) and \( T_6 \) were statistically at par in both the years separately.

10. There had been considerable improvement in weight of 100-kernels with \( T_{11} \) over all other treatments in both the years separately and in their pooled result when it brought about 23.9 percent increase in \( T_{11} \) over \( T_2 \) (Farmer’s practice)
11. The pod yield (q/ha) improved considerably at T₁₁ in both years and also in pooled results of two years though it was found statistically at par with T₁₀ and T₆ in pooled result securing 26.53 percent higher pod yield than T₂. In separate years, it had been no significantly different from T₁₀, T₆ and T₁₂. (RDF + PSB + 20 kg S)

12. Total uptake of nitrogen improved significantly under the effect of T₁₁ with no statistical variation from T₆ and T₁₀ in pooled result of two years. However T₁₁ did not differ significantly from T₆, T₁₀ and T₁₂ in both years separately. The improvement of total uptake of nitrogen was 26.59 percent over T₂. (Farmer’s practice)

13. The total uptake of sulphur improved significantly in T₁₁ which was statistically at par with T₆ and T₁₀ in pooled result of two years. In individual years the position was status quo with addition of T₉ and T₁₂. The total uptake of sulphur was 26.57 % more in T₁₁ than T₂.

14. The net profit and benefit cost ratio in T₁₁ were Rs. 28829.65 and 1:1.61 against Rs. 21221.44 and 1:1.34 in T₂ (Farmer’s practice).

Field peas

1. There was no statistical variation among treatments in regard to plant stand after germination as well as that of maturity in both years and in pooled result.

2. Significant enhancement in number of branches per plant with T₁₁ was observed over other treatments except T₁₀, T₆, T₉ and T₅ in pooled result of two years in which case T₁₁ brought about 20.6 percent increase in number of branches over T₂. Similar effects of treatments were almost similar in different years.
3. Maximum number of functioning leaves per plant was found under the effect of T_{11} which was significantly higher than all treatments in pooled result of two years though it did not differ significantly from T_{6}, T_{9}, T_{10} and T_{12} in different years.

4. The fresh weight of foliage was the highest in T_{11} though it did not differ significantly from T_{5}, T_{6}, T_{8}, T_{9}, T_{10} and T_{12} in different years and in pooled data. The percentage increase in T_{11} over T_{2} was 9.10.

5. The effect of treatments in regards to dry weight of foliage per plant was almost similar to fresh weight of foliage per plant when T_{11} enhanced dry weight of foliage over T_{2} by 9.27 percent in pooled data.

6. The number of pods per plant increased significantly in T_{11} over other treatments in different years and also in pooled data of two years. T_{11} had a margin of 47.19 percent over T_{2} in number of pods per plant in the pooled result.

7. The dry weight of pods per plant enhanced considerably under the effect of T_{11} which was significantly higher than other treatments in pooled result though in individual years it did not vary significantly from T_{6}. The dry weight of pods per plant was 46.94 percent more than T_{2} (farmer’s practice) in pooled results.

8. The number of seeds per plant was significantly the highest in T_{11} in pooled result though it was not at statistical variance from T_{5}, T_{6}, T_{9}, T_{10} and T_{12} in both years separately. In pooled result T_{11} produced 22.8 percent higher number of seeds per plant than T_{2}. (farmer’s practice)
9. The weight of seeds per plant was the highest with $T_{11}$ in pooled result and also in first year which was significantly more than other treatments, while it did not differ significantly from $T_6$ in first year. The weight of seeds per plant was enhanced by 46.8 percent in $T_{11}$ over $T_2$ in pooled result.

10. The weight of 100-seeds was found significantly the highest in $T_{11}$ different years and in pooled result.

11. $T_{11}$ being at par with $T_6$ enhanced the seed yield of pea (q/ha) significantly over other treatments in pooled result and also in both years where $T_{10}$ was also statistical at par with $T_{11}$, indicating thereby the effectiveness of RDF alone or in presence of PSB under residual effect of 20 q, 30 q FYM. Use of PSB and sulphur did not cause significant increase in yield. There was 48.58 percent increase in yield in $T_{11}$ over $T_2$ in pooled data.

12. The total uptake of nitrogen was significantly enhanced with $T_{11}$ over other treatments in pooled result and also in separate year's effects. There was 48.6 percent more total uptake of nitrogen with $T_{11}$ over $T_2$ in pooled result.

13. The total uptake of sulphur was improved significantly under the effect of $T_{11}$ which was found statistically at par with $T_6$ and $T_{10}$ in different years and also in pooled result in which case $T_{11}$ enhanced sulphur uptake by 48.67 percent over $T_2$.

14. $T_{11}$ having the highest net returns from peas produced higher net profit of Rs. 58293.57 than $T_2$. It had the benefit cost ratio of 1:4.52 against 1:3.21 of $T_2$ (Farmer's practice).
Summer groundnut

1. The plant stand after germination and at harvest did not show significant variation among different treatments.

2. \( T_{11} \) having produced significantly higher number of branches per plant was found statistically at par with \( T_6, T_{10} \) and \( T_{12} \) in individual years and in pooled results.

3. The number of functioning leaves per plant was significantly the highest in pooled means with \( T_{11} \) which did not differ significantly from \( T_{10} \) in different years.

4. The fresh weight of foliage per plant was the maximum with \( T_{11} \) which did not differ significantly from \( T_6 \) and \( T_{10} \) in pooled results of two years. There had been an increase of 4.36 percent with \( T_{11} \) over \( T_2 \). The results in different years were similar to each other indicating the significant supremacy of \( T_{11} \) over \( T_1, T_2, T_3, T_4 \) and \( T_7 \).

5. The dry weight of foliage per plant was maximized at \( T_{11} \) which was at par with \( T_5, T_6, T_8, T_9, T_{10} \) and \( T_{12} \) in pooled means also in individual years data. The percent increment in \( T_{11} \) over \( T_2 \) was 12.74.

6. The highest number of pods per plant was recorded at \( T_{11} \) which was superior to all other treatments in pooled data but not with \( T_6 \) in different years. The percentage increase with \( T_{11} \) was 44.40 over \( T_2 \).
7. The dry weight of pods per plant was significantly the highest with $T_{11}$ in pooled means and in individual years though it did not differ significantly from $T_6$ in different years. There was increase of 26.6 per cent in $T_{11}$ over $T_2$.

8. The number of kernels per plant was the highest in $T_{11}$ which was statistically at par with $T_5$, $T_6$, $T_9$, $T_{10}$ and $T_{12}$ in pooled means and also in individual years. The percentage increase with $T_{11}$ over $T_2$ was 20.18 in pooled result.

9. The weight of kernels was significantly the highest in $T_{11}$ in pooled data though it did not vary significantly from $T_6$ in different years. $T_{11}$ caused 46.52 percent increase over $T_2$ in pooled mean.

10. The weight of 100-kernels being the maximum with $T_{11}$ was significantly higher than all other treatments in pooled means and in separate years. This caused 53.7 percent more weight of 100-kernels than $T_2$ in pooled result.

11. The maximum pod yield per hectare was recorded at $T_{11}$ which was significantly not more than $T_6$ and $T_{10}$ in pooled means. The result was almost similar in separate years also. It is thus clear that PSB was of little value in promoting yields. How-ever the residual effect of FYM alongwith PSB was perceptible. The pod yield increased by 24.1 percent in $T_{11}$ over $T_2$ in pooled result.

12. The maximum uptake of total nitrogen in $T_{11}$ was statistically at par with dose of $T_6$, $T_{10}$ and $T_{12}$ in pooled results and also in individual years. The total uptake of nitrogen was 24.13 percent more in $T_{11}$ over $T_7$ in pooled means.
13. The total uptake of sulphur was also enhanced in T_{11} which was at par with T_{12} (having the sulphur as a content), T_{10} and T_{6} in pooled means. The results of individual years were almost same in different years.

14. T_{11} brought about the maximum net return which was higher by Rs. 23195.35 than T_{2}. The B:C. ratio was found maximum (1:1.22) with T_{11} (RDF + 30 q FYM + PSB).

**Conclusion**

In view of the results summarized above the following conclusion may be drawn.

1. The recommended doses of 20 N, 30 P_{2}O_{5} and 45 K_{2}O kg (RDF) alongwith 30 q FYM and 2 kg PSB, per hectare (T_{11}) maximized the yield of kharif groundnut though it was statistically at par with RDF + 30 q FYM/ha and also RDF + 20 q FYM/ha + 2 kg PSB per hectare. The use of PSB was found effective with the low dose of 20 q FYM supplemented with 2 kg PSB per hectare in presence of the recommended doses of fertilizers.

2. The nutrient requirement of field pea was assessed as 20 N, 60 P_{2}O_{5} and 40 K_{2}O (RDF) with residual effect of 30 q FYM in presence of 2 kg PSB per hectare or with no PSB.

3. The requirement of summer groundnut was determined as RDF + residual effect of 30 q FYM applied to kharif groundnut and 2 kg PSB/RDF + residue of 30 q FYM/RDF + residue of 20 q FYM as these were significantly not different from each other.
4. The means of over all pooled yields of treatments in kharif groundnut field pea and summer groundnut were computed at 22.87, 30.31, 26.04 quintals per hectare respectively. However the maximum yield obtained under T11 (RDF + 30 q FYM + PSB) were secured as 26.04, 305.6 and 26.12 quintals per hectare of kharif groundnut, field pea and summer groundnut respectively in the sequence.

5. In economics of different treatments the RDF + 30 q FYM + PSB (T11) giving the highest net income of Rs. 110310.00 had the maximum benefit cost ratio of 1:2.21 in the cropping sequence of groundnut field pea and summer groundnut.

6. Groundnut , field pea and summer groundnut had 161, 173 and 175 kg per hectare the over all total uptake of nitrogen respectively in this cropping sequence.

As regards the over all total uptake of sulphur groundnut, field pea and summer groundnut had shown 16, 24, 18 kg per hectare respectively in this cropping system.

**Recommendation**

The application of per hectare recommended dose of fertilizers (20 N + 30 P2O5 + 45 K2O kg/ha) alongwith 30 quintals FYM or the recommended dose of fertilizers plus 20 quintal FYM supplemented with phosphate solubilizing bacteria (PSB) to rainy season groundnut and the same treatments with residual FYM to succeeding field pea and summer groundnut may be recommended for the cropping sequence of groundnut—field pea—summer groundnut in condition of central Uttar Pradesh.