Chapter VI

SUMMARY

An ongoing field experiment entitled, “Effect of long term integrated nutrient management system on soil and crop productivity in rice-wheat crop sequence” was continued at Bhadiarkhar Farm of Department of Agronomy, CSK Himachal Pradesh Krishi Vishvavidyalaya during the year 2005-06 and 2006-07 with the following objectives:

1. To monitor the changes in production levels in relation to different nutrient management systems over the years
2. to develop suitable integrated nutrient supply and management system in cereal-based cropping sequence
3. to study long-term effect of conjunctive use of fertilizers and manures on system productivity and soil properties.

The experimental farm is situated at 32°6’ N and 76°3’ E longitude at an elevation of 1223.7 m above mean sea level in North-Western Himalayan region and has sub-tropical humid climate. The soil of the experimental field was silty-clay loam in texture, acidic in reaction, medium in available phosphorus, potassium and organic carbon and high in available nitrogen at the time of inception of the experiment in 1991.

The observations on growth characters viz. plant height, dry matter accumulation, number of leaves and number of shoots per metre square were recorded at fortnightly interval in rice and at monthly interval in wheat, besides yield and yield attributes of both crops, nitrogen, phosphorus and potassium contents and uptake by grain and straw were determined at harvest. The soil physico-chemical properties were studied by analyzing soils for bulk density, pH, organic carbon, available N, P and K after each crop season. Important findings of the study have been summarized as under:

6.1 Growth of rice and wheat

i. Plant height of both the crops during both the years increased progressively up to maturity stage.
It was highest in $T_6$ treated plots in both the crops but was statistically similar to treatment $T_5$, $T_8$ and $T_{10}$. Farmers’ practice of fertilizer application ($T_{12}$) resulted in significant increase in plant height over control ($T_1$) in both the crops.

ii. Number of shoots increased up to 60 DAT in rice and up to 90 DAS in wheat crop and thereafter showed a declining trend till maturity. Consistently highest number of shoots per metre square were recorded under treatment $T_6$ in both the crops. In rice crop it did not produce significant difference from treatments $T_5$, $T_7$, $T_8$, $T_{10}$ and $T_{11}$. In wheat crop $T_6$ was at par with $T_5$ only during both the years. Farmers’ practice of fertilizer application was significantly inferior to most of the treatments but significantly better than the control.

iii. Dry matter accumulation in both the crops during both the years increased progressively up to maturity stage with maximum dry matter accumulation in treatment $T_6$, which did not differ significantly from treatments $T_5$, $T_7$ and $T_{10}$. Farmers’ practice of fertilization was significantly superior to control ($T_1$) but inferior from most of the treatments during both the years.

iv. Number of leaves in rice also increased up to 60 DAT and thereafter showed a declining trend till maturity. It was also highest in treatment $T_6$ but did not show significant difference from $T_5$, $T_8$, $T_7$ and $T_{10}$ during both the years. $T_1$ (control) was inferior to most of the treatments including Farmers’ practice of fertilization ($T_{12}$).

6.2 Development stages

i. Days to flowering and maturity in both the crops occurred significantly late in control plots ($T_1$) while it was earliest in $T_6$ plots except days to maturity in wheat crop, which was not significantly influenced.

ii. Increase in NPK levels from 50 to 100 % of the recommended fertilizers resulted in significantly earlier flowering and maturity of rice and wheat.

6.3 Yield attributes and yield

i. Maximum number of panicles and spikes during both the years were recorded in treatment $T_6$ which was at par with $T_5$, $T_7$ and $T_8$ during both the years. Farmers’ practice of fertilization ($T_{12}$) although significantly inferior to all the treatments yet it was superior to the control.

ii. Number of spikelets per panicle in rice was highest in $T_6$ followed by $T_{10}$ but statistical
differences due to different nutrient management practices were found to be non-significant during both the years of experimentation. In wheat number of grains per spike during both the years was maximum in treatment $T_7$ which did not differ significantly from $T_6$, $T_3$, $T_8$ and $T_{10}$.

iii. The 1000-grain weight in rice was not influenced significantly due to different treatments during both the years. In wheat, it was highest in treatment $T_6$ which did not differ significantly from $T_5$, $T_3$ and $T_{10}$ during 2005-06. Similarly treatment $T_5$ did not differ significantly from $T_7$, $T_{10}$ and $T_8$ but significantly increased the test weight over rest of the treatments.

iv. Grain and Straw yield of both rice and wheat were highest in plots receiving 50% NPK through fertilizers and 50% N through FYM to rice and 100% NPK through fertilizer to wheat ($T_6$) but it did not differ significantly from the treatments where 100% recommended NPK to both the crops was applied through chemical fertilizers ($T_3$). Similarly, conjoint use of wheat cut straw ($T_8$) or green manure ($T_{10}$) to the extent of 50% N produced statistically similar yield as with 100% NPK application to both the crops. Grain and straw yield of both the crops were significantly lower in control plots as compared with all the treatments including Farmers' practice of fertilizer application.

v. Among the purely chemical fertilizer application treatments, all the yield attributes and yield were highest when 100% NPK was applied to both crops. It was followed by 75% NPK whereas lowest values were recorded with 50% NPK.

6.4 Nutrient Uptake

i. N, P and K uptake by both rice and wheat during both the years were significantly higher in $T_6$ treatment where 50% NPK through fertilizers and 50% N through FYM to rice and 100% NPK to wheat through fertilizers was applied. $T_6$ was at par with $T_5$ (100% NPK to both the crops).

ii. Uptake in purely 100% chemical fertilized plots ($T_3$) was at par with treatments $T_{10}$ and $T_7$ in both the crops and with treatment $T_8$ in case of wheat crop.

iii. Farmers' practice of fertilization ($T_{12}$) was superior to control ($T_1$) but inferior to other treatments.

6.5 Grain productivity and trends

i. Year to year variation in yield of both the crops was considerably high.

ii. Among the various treatments, $T_6$ consistently maintained higher yields of both rice and wheat
and therefore the rice equivalent yield, with corresponding average yield of 3341 kg/ha, 3225 kg/ha and 6334 kg/ha.

iii. The trend analysis revealed that the productivity of wheat and rice equivalent yield decreased while that of rice, except in T₃, T₉, T₁₁ and T₁₂, increase was noticed. In statistical terms, the regression coefficients were not significant.

iv. The sustainability indices of rice and rice equivalent yield were more than 0.5 in all the treatments. Whereas in wheat, it was sustainable (>0.5) only in T₅, T₆ and T₇.

6.6 Soil properties

i. Bulk density of the soil was not influenced significantly due to different treatments during both the crop seasons as well as years.

ii. Soil pH was influenced significantly only during 2005-06 after harvest of wheat crop which was highest in T₆, while differences among all other treatments were not significant.

iii. Organic carbon content was consistently highest in T₆ treatment followed by T₇ and T₈. There was increase in organic carbon content from initial status at the end of experimentation.

iv. Available N content after each crop seasons was maximum in treatment T₆ and it did not vary significantly from treatment T₇ in wheat crop. T₅ being the second best treatment was at par with T₁₁ and T₁₀ in wheat crop. In rice crop second best treatment was T₁₀ which was at par with T₁₁. Irrespective of the treatments, there was a general depletion in available N status of soil after 16 years of experimentation.

v. Available P content was maximum in treatment T₆ in wheat crop and T₃ was second best treatment and treatments T₇, T₈ and T₁₀ were at par with each other during both the years. In rice crop available P content was maximum in treatment T₈ during both the years. Treatment T₆, T₁₁ and T₇ were at par with each other and also treatments T₅, T₉ and T₁₀ did not vary significantly from each other. Available P status showed a tremendous build up over the initial value in all the treatments except control.

vi. Available K content was maximum in treatment T₄ after harvest of rice and in treatment T₆ after harvest of wheat. Like available N, available K exhibited depletion over initial status at the end of experimentation.

vii. Microbial biomass, unlike most of the other soil properties, was maximum in plots.
receiving 50% NPK through fertilizers and 50% N through wheat cut straw to rice and 100% NPK to wheat (T₆). Farmers’ practice of fertilization (T₁₂) though inferior to most of the treatments but was superior than control (T₁).

CONCLUSIONS

i. Year to year variation in yield of both the crops was considerably high. Average productivity of rice was found to increase at the rate of 4.7 kg/ha/year in T₁ (control) to 36.9 kg/ha/year in T₆ (50% NPK+50% N (FYM) to rice and 100% NPK to wheat). However, in T₂, T₉, T₁₁ and T₁₂ (Farmer’s practice) average yields of rice showed a negative growth. In case of wheat as well as rice equivalent yield (REY), on the other hand, irrespective of the treatments, yield levels exhibited a declining trend over the years.

ii. Averaged over the 15 years of experimentation, highest productivity of both rice and wheat and therefore the rice equivalent yield was recorded in treatment where 50% NPK through fertilizers + 50% N through FYM and 100% NPK to wheat (T₆) was applied. However, this nutrient management system was as productive as T₅, T₇, T₈ and T₁₀.

iii. Sustainable rice equivalent yield index was more than 0.5 in all the treatments and irrespective of the treatments the production system was sustainable.

iv. In the integrated nutrient management treatments (T₆ to T₁₂) there was a significant build-up in available P and organic carbon, decline in available N, and available K status was just maintained.